

Notes on the Birds of the Cocos-Keeling Islands

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(Completed, September 1949)

Contents

	Page
Introduction	212
Part 1. Birds breeding on the Islands in 1941 ..	217
Part 2. Checklist of the birds known from the Islands ..	259
References	268

Introduction

This paper, which has been prepared in two independent sections, is based primarily on collections and field notes made on the Cocos-Keeling Islands between about 10 December 1940 and 10 November 1941. During this period the author lived on Pulo Tikus, on the main atoll, and was able to make two visits to the isolated island of North Keeling, the first on 30 January and the second, of two days, on 7 and 8 July. A general description of the group is given in the introductory paper at the beginning of this Bulletin. A more detailed account of the history of the Islands up to 1941, also prepared by the present writer, appears in the *Journal of the Malayan Branch of the Royal Asiatic Society*, Vol. 20, pt 2 (1947: 140-202), and of the form and ecology of the island of North Keeling in the same *Journal*, Vol. 21, pt 1 (1948: 68-103). A general account of the birds of the group is given in the *Ibis*, Vol. 91 (1949: 221-243), and a more detailed description of the nesting habits of some of the sea birds, based partly on data obtained on Christmas Island between September 1938 and December 1940, appears in the *Journal of the Bombay Natural History Society*, Vol. 48, pt 2 (1949: 214-35).

The first section of this paper deals in some detail with the birds that were breeding on the Islands in 1941. Unless otherwise stated all measurements quoted for specimens taken by the present writer were made in the flesh and are expressed in mm. Tail measurements are from the base of the centre feathers to the tip of the longest feather. Measurements of the exposed culmen were taken from the base of the feather tract. The second section of the present paper consists of an annotated checklist of the birds known authentically to have occurred on

the group in the introductory paper. References to the eastern Islands.

Representative nesting in the which 4 have (Gallus vari only indigenous the Philippine northern Australian region but it has proper. They include with isolate Phaethon—

The Phaethon which has which one 9 sea birds islands, the (lepturus) n The breeding as follows,

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Fregata

Phaethon

NOTES ON THE BIRDS OF THE COCOS-KEELING ISLANDS

the group in a feral state. Doubtful records are discussed in the introduction to it, which also gives a brief summary of the earlier collections made on the islands. It is followed by a combined list of references covering both sections of the paper. References to Christmas Island are in all cases to the island in the eastern Indian Ocean (lat. 10° 25-34' south, long. 105° 34-46' east), approximately 530 miles east of the Cocos-Keeling Islands.

Representatives of 17 different species were found to be nesting in the group in 1941. Five of these are land birds, of which 4 had been introduced, 2 from Christmas Island and 2 (*Gallus varius* and *Padda oryzivora*) probably from Java. The only indigenous bird is *Rallus philippensis andrewsi*, a race of the Philippine Rail. Subspecies of this bird are known from northern Australia and from a number of islands in the Australian region and the Philippine and Austro-Oriental subregions, but it has never been reported from the Malaysian subregion proper. The remaining 12 species are all sea or coastal birds. They include representatives of all the genera usually associated with isolated tropical islands—*Anoëus*, *Gygis*, *Sula*, *Fregata* and *Phaëthon*—together with a *Demigretta* sp. and *Puffinus pacificus*.

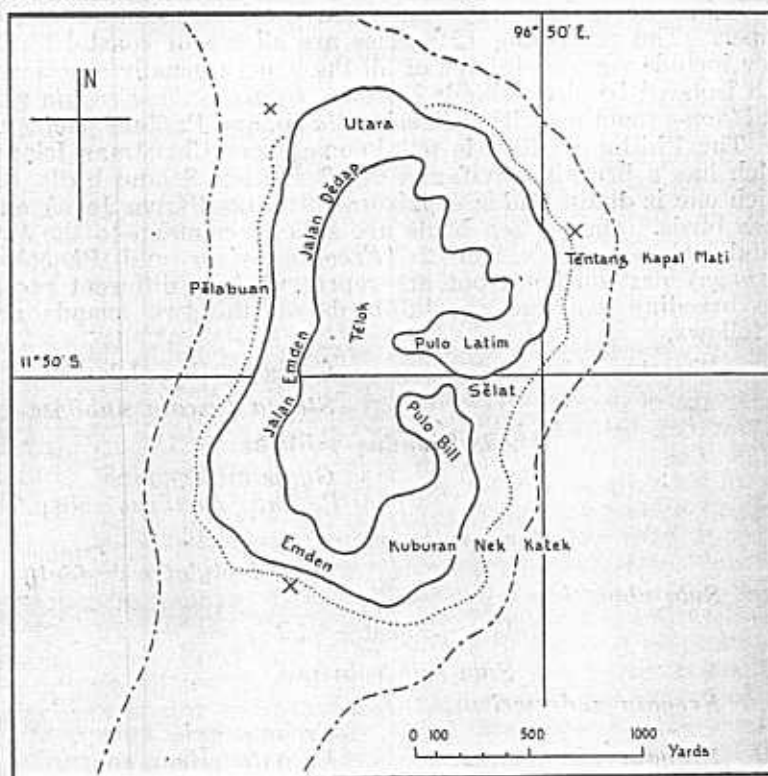
The Philippine Rail is not known from Christmas Island, which has a breeding avifauna of 17 species, 8 land birds (of which one is again *Padda oryzivora* introduced from Java) and 9 sea birds. Only 5 sea birds are strictly common to the two islands, though a further 2 (*Fregata minor* and *Phaëthon lepturus*) nest on both, but are represented by different races. The breeding sea and coastal birds on the two islands are as follows,

Christmas Island

Cocos-Keeling Islands

	<i>Sterna fuscata nubilosa</i>
<i>Anoëus stolidus</i>	<i>pileatus</i>
	<i>Gygis alba monte</i>
	<i>Puffinus pacificus</i> subsp.
<i>Demigretta sacra</i>	<i>sacra</i>
	<i>Sula dactylatra bedouti</i>
<i>Sula abbotti</i>	
	<i>Sula leucogaster plotus</i>
	<i>Sula sula rubripes</i>
<i>Fregata andrewsi</i>	
	<i>Fregata ariel</i> subsp.
<i>Fregata minor minor</i>	<i>Fregata minor</i> subsp.
	<i>Phaëthon rubricauda westralis</i>
<i>Phaëthon lepturus fulvus</i>	<i>Phaëthon lepturus lepturus</i>

The points of difference between these two lists are interesting, though it does not seem possible at the moment to find a satisfactory explanation for some of them. The Cocos-Keeling group has three terns against the one on Christmas Island, but at least one of the additional species, *Gygis alba*, might well have been expected on the latter. The Cocos-Keeling Islands are certainly the most easterly known breeding ground of the race *monte* (type locality, the Seychelles), but the species as a whole occurs widely across the Pacific. In addition it is known to be resident on several islands with a vegetation rather similar to that of Christmas Island. It keeps to isolated oceanic islands, but it cannot by any means be said to be restricted to coral atolls. The Sooty Tern, *Sterna fuscata*, obviously prefers a more open terrain, but against this the Noddy, *Anous stolidus*, has made itself at home on Christmas Island, where it is actually more numerous than on North Keeling.



A sketch map of the island of North Keeling, showing the local Malay names given to the various parts of it. The crosses mark the approximate sites of known wrecks.

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The other differences between the two sea bird populations include the replacement of *Sula abbotti* of Christmas Island, which breeds on tall trees inland, by *Sula dactylatra* of North Keeling, which normally nests on low-lying, bare ground near the shore. This is clearly an ecological distinction. So may be the replacement of Christmas Island's *Fregata andrewsi*, which again breeds in tall trees, though this time near the coast, by *Fregata ariel*, which favours banks of *Pemphis acidula* and other low-growing shrubs. At the present time *andrewsi* is not known with certainty to be breeding on any other island, but it seems probable that there is also a colony on the Anamba Islands, in the South China Sea, about 900 miles almost due north of Christmas Island. If this is so it will be of great interest to learn exactly what habitat it favours there.

The basis of the racial distinction of *Fregata minor* and *Phaethon lepturus* is less obviously ecological. The two forms of *F. minor* are naturally occupying rather different nesting sites on the two islands, but the typical race, *F. m. minor*, is known to breed on *Pemphis* in parts of its range. Similarly *P. lepturus fulvus* has a specialized nest site on Christmas Island, in that it usually breeds in hollows in the trunks of tall dying trees, but it could find a few suitable places on the Cocos-Keeling Islands. Also, why is not *P. l. lepturus*, the typical race, on Christmas Island in place of it? These birds range widely, and as we know *lepturus* itself breeds in hollows in the trunks of dead trees in parts of its range in the Indian Ocean (data summarised in Gibson-Hill, 1950). Again the *P. lepturus* subsp. reported by Bartels (1937: 16-19) to be nesting on an island off the coast of Java must almost certainly be the typical race: his informant could hardly have failed to note and report the rich golden apricot colour of *fulvus*. This, if accepted, extends the range of *P. l. lepturus* to the east of Christmas Island.

There can scarcely be any great difference in the marine foods available in the sea off the two islands. Two species, *Anous stolidus* and *Sula rubripes*, are numerous on both, while a second booby, *Sula leucogaster*, which is plentiful on Christmas Island, occurs in small numbers on North Keeling. It would, in fact, seem that though the sea bird populations are clearly distinct, this can be attributed only partly to the markedly different structure and vegetation of the two islands, and even less to the available foods. It cannot even be said that the sea bird fauna of Christmas Island has clearly come from further east, and that from the Cocos-Keeling Islands from the western Indian Ocean. There is no doubt that several points in the subspecific standing of the birds of the Indian Ocean need clarification; but as far as the existing definitions take us we

find that the Cocos-Keeling Islands have approximately equal affinities with the west and the east. Three common sea birds, *Sula sula rubripes*, *S. leucogaster plotus* and *Anous stolidus pileatus*, nest on both islands and in localities spreading widely both east and west of them. One bird, *Sula abbotti*, has its most easterly known breeding ground on Christmas Island, and one, *Fregata m. minor*, its most westerly. One bird, *Phaethon lepturus fulvus*, is restricted to this island, while a second occurs only on it and possibly on an island due north of it. Three birds, *Demigretta s. sacra*, *Sula dactylatra bedouti* and *Phaethon rubricauda westralis*, are at or near their most westerly nesting grounds on the Cocos-Keeling Islands, while probably only two, *Gygis alba* and *P. l. lepturus*, are at the eastern extent of their range. This last figure is based on the assumption that the two frigate-birds and the shearwater occurring on the Cocos-Keeling Islands are peculiar to it. Should the frigate-birds prove to be of the Mascarene forms this figure becomes four on these grounds. On the other hand it may well be necessary to remove *P. l. lepturus* (see above) and place it in the category of the birds known to nest both east and west of the two islands.

There is a further interesting point in which some of the sea birds of the Cocos-Keeling Islands differ in detail from those on Christmas Island. This is in the matter of the timing of the breeding season. In several cases the peak period for egg-laying is slightly, or even appreciably, different on the two islands. Briefly one can say that on Christmas Island the two *Fregata* lay from the middle of March to the end of June, while on North Keeling the two birds lay between the beginning of May and the beginning of July. *Sula sula rubripes*, on the other hand, lays mostly during the last week in May or in June on Christmas Island and between April and June on North Keeling. These differences are slight, but they show the *Fregata* laying a little later on the latter island, and the *Sula sula* a little earlier. The data available on *Sula leucogaster* and the *Phaethon* spp. is probably not sufficient for a comparable analysis. The behaviour of the Noddy, *Anous stolidus*, however, is extremely interesting. On Christmas Island it lays mostly in May and June, that is at about the same time as the other sea birds. On the Cocos-Keeling Islands it lays from late December to early March. This puts its breeding season four to five months earlier, and in the latter half of the southern summer, though the Cocos-Keeling Islands are only about one and a half degrees further south of the equator. We also find that two other sea birds on these islands are probably following much the same routine. *Sterna fuscata* seemingly laid in November or early December in 1940, and the shearwater certainly normally lays there in October and November. These

points are discussed in slightly more detail in the notes below on the Noddy and the Sooty Tern. In summary one can say that the months from May to August cover at least the peak egg-laying period for these and other sea birds on Christmas Island and, as far as has been recorded, on most other islands in the tropical Indian Ocean. On the other hand September to January, the months of the southern spring and early summer, is the period during which the Sooty Tern and the Lesser Noddy, *Anous tenuirostris*, nest on Houtman's Abrolhos, off the coast of western Australia, 1,500 miles south-east of the Cocos-Keeling Islands, and November the month in which the Wedgetailed Shearwater lays there.

Part 1

The Birds breeding on the Cocos-Keeling Islands in 1941.

The following seventeen birds were found breeding on the islands in 1941. Introduced species are marked with an asterisk. In addition there were a number of feral domestic Fowl on North Keeling, descended from birds liberated when regular visits were being made to the island.

* *Gallus varius* (Shaw & Nodd.). Green Jungle-fowl.

Phasianus varius Shaw and Nodder, Nat. Misc., x, 1798, pl. 353: Java.

(*Gallus bangkiva*, Forbes, 1885, p. 44.)

Local name, "*Ayam Alus*".

The following skins were retained and are now in the Raffles Museum collection. All four were taken on Pulo Panjang (West Island).

Coll. No.	Date	Sex	Total Length	Tail	Wing Flat	Tarsus	Bill to Gape	Exposed Culmen
CG1.	19:2:41	♂	648	292	233	88	31	18
CG2.	3:3:41	♂	611	260	230	85.5	29	17
CG3.	3:3:41	♀	441	124.5	198	75	29	16.5
CG4.	3:3:41	♀	442	130	203	76	28	16.5

Soft parts: iris, chrome yellow; in the male, the facial skin purplish madder, the base of the neck chrome yellow with a bright blue patch in the midline, the wattle chrome, and the comb mauve with its base bright blue green; in the female, the bare areas are light grey-blue with the eyelids dark brown; bill, black in the male, dropping to off-white on the lower surface, and in the female dark grey-brown, paler at the tip; legs, off-white or a pale watery grey; feet, grey.

According to Forbes (1885: 44) "*Gallus bangkiva*" (sic) had been introduced on Pulo Panjang, in the main atoll, before the time of his visit in 1879.¹ Wood-Jones (1912: 300) says

¹ Forbes (tom. cit.: 34) says "introduced from Java," but both *bangkiva* Temm. and *varius* occur in Java.

that all the wild fowls to be seen during his stay were domestic fowls run wild. On the other hand, the late J. S. Clunies-Ross told me that his father had liberated the ancestors of the present stock on Pulo Panjang about 1880. It seems most probable that these were the birds that Forbes saw (he did not collect any specimens) and that Wood-Jones, who overlooked several other species, failed to find them. They do not seem to have multiplied rapidly, in spite of the fact that they were nominally protected by the Clunies-Ross family. In 1941 they were still confined to Pulo Panjang, where there were probably less than 200 adults all told. They were shy and elusive, and kept well in cover among the denser vegetation. No nests were seen.

Rallus philippensis andrewsi (Math.). Philippine Rail.

Eulabeornis philippensis andrewsi Mathews, Bds. Austr. 1, 1911, p. 199: Cocos-Keeling Islands.

Rallus philippensis, Forbes, 1885; p. 44.

Rallus philippiensis (sic), Wood-Jones, 1912, p. 338.

Local name, "Ayam Utan."

The following skins were retained and are now in the Raffles Museum collection. They were all taken on Pulo Luar (Horsburgh Island).

Coll. No.	Date	Sex	Total Length	Tail	Wing Flat	Tarsus	Bill to Gape	Exposed Culmen
CP1.	25:12:40	♂	298	73	78+	50	37	30.5
CP2.	14: 1:41	♂	304	64	152	47.5	40	33
CP4.	17: 1:41	♂	300	63	142	51	38	32
CP7.	20: 1:41	♂	304	73	142	50	39	32
CP9.	20: 1:41	♂	316	73	147	49	40	34
CP11.	20: 1:41	♂	289	71	133	51	36	29
CP15.	24: 2:41	♂	296	72	111	48	36	29
CP16.	24: 2:41	♂	304	65	103+	49	40	32
CP17.	27: 2:41	♂	308	75	152	52	40	32
CP3.	17: 1:47	♀	296	67	141	50	35	29
CP5.	17: 1:41	♀	292	70	141	46	34	28.5
CP6.	20: 1:41	♀	296	70	148	50	36	30
CP8.	20: 1:41	♀	278	59	128	45	36	29
CP10.	20: 1:41	♀	280	70	135	47	38	32
CP12.	21: 1:41	♀	279	60	136	47	32	26
CP13.	21: 1:41	♀	306	59	137	49	36	29
CP14.	17: 2:41	♀	295	70	139	48	33	28
CP18.	27: 2:41	♀	294	62	66+	50	34	28

Soft parts: no apparent difference between the colouring of male and female birds; iris, red-brown; eyelids, grey-brown; bill, pinkish grey or mulberry brown, darker and browner along the dorsal surface of the maxilla and sometimes pinker at the base of the mandible; legs and feet, grey.

NOTES ON THE BIRDS OF THE COCOS-KEELING ISLANDS

On the measurements recorded in mm. above it would seem that the female is slightly smaller than the male; total length, ♂ 289-316 av. 302, ♀ 278-306 av. 291; tail, ♂ 63-75 av. 70, ♀ 59-70 av. 65; wing flat, ♂ 111-152 av. 140, ♀ 128-148 av. 138; tarsus, ♂ 47.5-51 av. 50, ♀ 45-50 av. 48; bill to gape, ♂ 36-40 av. 38, ♀ 32-38 av. 35; exposed culmen, ♂ 29-34 av. 31.5, ♀ 26-32 av. 29. The Raffles Museum collection also contains two specimens sent up to Singapore in spirit by the Clunies-Ross family and subsequently skinned.

This is a local race, peculiar to the group, of a bird which occurs widely in the Philippine, Austro-Oriental, Australian and Polynesian sub-regions. None of these areas are near the Cocos-Keeling Islands, and it has never been recorded in the Malaysian sub-region proper. Its presence in the Cocos-Keeling group is difficult to explain, unless it is descended from birds liberated by 17th or 18th century visitors to the island. We know from Keating's observations (quoted in Holman, 1846: 382) that it was there as early as 1829. He makes mention of only a few species. Presumably the rail was at least fairly common and widespread during his stay on Cocos or he would not have referred to it. Forbes (1885:44) says that in 1878 it was found in great abundance, but he does not say on which islands. It was certainly not "abundant" in 1941, but as it is edible it is surprising that it has survived anywhere on the main atoll.

In 1941 *philippensis* was plentiful on Pulo Luar and North Keeling, and present but less common on Pulo Selma and Pulo Panjang. It mostly frequents the open grassy patches or the wooded areas adjacent to them. It is a typical rail in its habits, and flies reluctantly and only for short distances. It nests on the ground, laying normally (according to local information) 4-6 eggs in a small, virtually unlined depression at the base of a clump of grass. I saw two nests, each containing 5 eggs, the first in May and the second in June. The eggs were almost round; the ground colour was pinkish buff, blotched and speckled with reddish and purplish brown. The moult in the specimens examined on the atoll, together with those retained, suggests that breeding normally ends between August and October. If that is so it means that this species lays during the latter part of the rainy season.

Sterna fuscata nubilosa Sparrm.

Sooty Tern.

Sterna nubilosa Sparrman, Mus. Carls., fasc. 3, 1788, No. 63; "India Orientalis".

Sterna fuliginosa, Wood-Jones, 1912, p. 338.

Local name, "Burong Dali". This name is also used for the Bridled Tern, *S. anæthetus antarctica* Less.

Mus. 22, 1950.

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RAFFLES

The following nine skins were retained and are now in the Raffles Museum collection. Nos. 9, 20 and 21 were taken at sea off Pulo Tikus (Direction Island); the remainder were taken on North Keeling.

Coll. No.	Date	Sex	Total Length	Tail	Wing Flat	Tarsus	Bill to Gape	Exposed Culmen
V1.	30: 1:41	♂	430	171	279	31	62	45
V3.	30: 1:41	♂	416	163	300	30	57	43
V7.	5: 7:41	♂	443	181	295	30.5	63	44
V8.	5: 7:41	♂	425	166	284	30	62	44.5
V9.	24: 9:41	♂	444	174	287	30.5	62.5	45
V2.	30: 1:41	♀	429	170	300	31	59	44
V4.	30: 1:41	♀	407	132	275	30	60	42
V20.	30:10:41	♀	372+	129+	291	30.5	59	42
V22.	2:11:41	♀	432	180	289	31	59	41

Soft parts: no apparent difference between the colouring of male and female birds; iris, dark brown; eyelids, bill, legs and feet, black.

Typically the Sooty Tern occurs in our area only as a breeding visitor to North Keeling, where it nests on the crest of the shingle beach on the northern section of the east side of the island. Relatively few birds were present in 1940-41. During the breeding season they occasionally fly across to the vicinity of the main atoll, and solitary individuals can generally be seen fishing over the open sea between the two islands. In 1940 the birds apparently laid in November and December; and we found 5 chicks in down, but no eggs, on my first visit to North Keeling at the end of January, 1941. The majority of the birds left the neighbourhood of the islands in February and early March, and from the latter month onwards very few were seen. During the July visit to North Keeling we found no evidence of active nesting and encountered only three adults in two days. No further landings were possible that year, but from mid-September onwards the Sooty Tern was again seen over the open water between North Keeling and Pulo Luar, and on several occasions birds visited the lagoon of the main atoll. While sailing near North Keeling towards the end of October, I counted over 40 terns fishing in the lee of the island.

According to the local Malays, who are very partial to its eggs, the Sooty Tern was formerly plentiful on North Keeling. They told me that previously they had generally found two large colonies in the area where I saw the 5 chicks. Unfortunately they could not remember the dates when they had collected the eggs more precisely than that it must have been some time

NOTES ON THE BIRDS OF THE COCOS-KEELING ISLANDS

between November and February. On the other hand Wood-Jones (1912: 338) gives this bird as nesting on North Keeling "but not in very great numbers". It was not breeding when he visited the island, in June 1906, and it is possible that my informants were correct and that the bird was formerly much commoner there. Alternatively they themselves may have exaggerated the numbers that they expected to find on the island; very few visits had been made in the ten or twelve years previous to my landings. Finally it is possible that the birds do still reach North Keeling in some numbers but January and July (in 1941 at least) were the wrong months in which to look for them. Mathews & Iredale (1921: 100) give the breeding season on Houtman's Abrolhos, off the west coast of Australia (about 28° s. lat.) as December and January; they also note September to November for Norfolk Island, and May and June for the Torres Strait area (about 10° s. lat.). In the north-western portion of the Indian Ocean the breeding season seems to be round the time of my July visit, when no nests were found. Vesey-Fitzgerald (1941: 518) says that the Sooty Tern breeds in the Seychelles from June onwards, with young birds leaving by the end of October. In 1942 Major North (1946: 500) stayed on Mait Island, in the Gulf of Aden, from 22-26 November and saw no Sooty Terns, but was told by a local informant that they nest there in great numbers from June onwards and are away by the beginning of October. According to Moreau (1940: 54; quoting Reichenow, 1900) Fischer found *fuscata* breeding on Mafia (? or one of the adjacent islets) off the east coast of Africa from June to August. This island is south of the equator and only 4 degrees north of the latitude of the Cocos-Keeling Islands, but again it suggests that we should have found eggs or chicks early in July, just as the Torres Strait data does. A possibility that remains is that the Sooty Tern behaves on North Keeling as it does on Ascension, which is in much the same latitude but in the south Atlantic. There it follows a regular rhythm of 9-10 months instead of 12. This moves the date of the nesting season forward, so that it is 2-3 months earlier each year (see Murphy: 1126-27). If this is so my first visit to North Keeling was made one year too late.

Anous stolidus pileatus (Scop.).

Common Noddy.

Sterna pileata Scopoli, Del. Flor. et. Faun. Insubr. ii, 1786, p. 92: Philippine Islands.

Anous stolidus, Forbes, 1885, pp. 32 and 44; Wood-Jones, 1912, p. 339.

Local name, "*Burong Krok*", from the bird's note.

Mus. 22, 1950.

[221]

RAFFLES

The following specimens were retained and are now in the Raffles Museum collection. They were taken at Tanjong Puri at the south end of Pulo Panjang (West Island).

Coll. No.	Date	Sex	Total Length	Tail	Wing Flat	Tarsus	Bill to Gape	Exposed Culmen
AS1.	15: 1:41	♂	439	169	280	23.5	60	44.5
AS2.	15: 1:41	♂	440	157	279	23.5	58	43
AS4.	15: 1:41	♂	460	168	290	24	61	43
AS5.	15: 1:41	♂	441	158	283	23	58	42
AS9.	12: 2:41	♂	431	158	283	24	57	41
AS11.	12: 2:41	♂	434	151	285	24	62	44
AS3.	15: 1:41	♀	439	162	279	23	59.5	42
AS6.	15: 1:41	♀	426	147	270	22	58	42
AS7.	12: 2:41	♀	416	150	271	24	59	42
AS8.	12: 2:41	♀	435	159	279	23.5	58	43
AS10.	12: 2:41	♀	438	162	288	23	60	42
AS12.	12: 2:41	♀	432	162	283	23	59	42

The present writer also collected the following specimens on the east coast of Christmas Island in November 1940. Specimens previously in the Raffles Museum collection are recorded by Chasen (1933: 63).

Coll. No.	Date	Sex	Total Length	Tail	Wing Flat	Tarsus	Bill to Gape	Exposed Culmen
D1.	5:11:40	♂	403	162	277	23	56.5	40
D3.	5:11:40	♂	402	150	267	22.5	56	38.5
D4.	5:11:40	♂	415	156	287	23	58	40
D7.	7:11:40	♂	392	147.5	265	23.5	56	39
D9.	7:11:40	♂	412	160	278	23.5	58	44
D11.	17:11:40	♂	415	159	277	24	56	40
D2.	5:11:40	♀	392	137	265	24	55	38.5
D5.	5:11:40	♀	439	164	287+	24	60	42.5
D6.	7:11:40	♀	417	158	278	23.5	59	43
D8.	7:11:40	♀	415	168	282	24.5	59	44
D10.	7:11:40	♀	400	146	269+	23.5	57	41
D12.	17:11:40	♀	433	170	292	25	58	41.5

Soft parts: no apparent difference between the colouring in the male and female birds; iris, very dark brown; bill, jet black; legs and feet, dark slightly purplish grey.

This bird breeds on North Keeling in large numbers during the early months of the year, mostly on the shingle ridges along the landward side of the east and south sea beaches. The peak period for laying is apparently from late December to the end of February. The Noddy is plentiful over the open sea between North Keeling and the main atoll from December to June, but the majority of the birds appear to leave the group outside the breeding season. Birds are scarce from July onwards, but a few juveniles with fragments of down on the belly and wings were present on North Keeling in July. In 1941 there was also a small group of approximately 20 pairs nesting on the crests of a clump of coconut palms at the south end of Pulo Panjang, in the main atoll. They arrived about the beginning of January and the majority had eggs towards the end of the month.

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On North Keeling the Noddy builds no real nest, but places its single egg in a suitable depression in the coral shingle or among the tufts of grass which in some places lie behind it. In most cases the hollow was not lined, but sometimes it contained a few dried leaves of *Tournefortia*. The egg is roughly ovoid in shape, slightly more pointed at one end, and with a fine matt surface. The ground colour ranges from a warm off-white to a very pale fawn, with a few light, dull grey or pale, purplish grey blotches, and above them a few fine or coarse, umber or dark umber, markings mostly at the broader end. Ten examples ranged in length from 50-54 mm. and in breadth from 34-37 mm; average, 52.9 x 36 mm. They were similar to a series of 30 examples taken on Christmas Island, which ranged from 51-56 mm. in length and 35-38 mm. in breadth.

The season for egg-laying on the Cocos-Keeling Islands calls for some comment. The Noddy is also a breeding visitor to Christmas Island, which lies in approximately the same latitude. There the majority of the birds lay in May and hatch their eggs in June. During the two years that I was on the island I found no eggs, and saw very few birds, between the beginning of September and the end of March. North (1946: 501) says that the Noddies arrive in huge numbers on Mait Island, in the Gulf of Aden, at the end of May and all leave by December. Von Heuglin found only old eggs, some addled and others dried, on a visit to the same island from 13-15 November; he was told that the birds begin nesting at the time of the change of the monsoon, that is about the first week in June (quoted from Archer and Godman (2), 1937: 549-50). Hoogerwerf (van Bemmelen and Hoogerwerf, 1940: 457-63) collected eggs and young birds of all ages on Gunong Api, in the Banda Sea, between 21 July and 11 August. Similarly the Raffles Museum has a number of eggs from Barren Island, off the western end of Borneo, taken by Sir John Anderson on a one-day visit on 25 June. Vesey-Fitzgerald (1941: 527) says that eggs are laid throughout the year on the Seychelles, but the main laying season is during July and August. Betts (1940: 492-3) reports breeding in full swing on Aride, south-west of the Seychelles, when he was there between 25 April and 8 May. Both the last two authors also suggest that this species is resident on their islands and does not forsake them outside the breeding season. Apart from this point, it will be seen that all the records quoted of nesting on islands in or adjacent to the Indian Ocean show laying between late April and August. Only on the Cocos-Keeling Islands do the great majority of these birds lay at the opposite time of the year, between the end of December and February. The explanation cannot lie in their position in regard to the equator, as Gunong Api also is south of it and Christmas Island is less than 1° 30'

north of North Keeling. Possibly there is an association with changes in Ocean currents or the movements of surface water whose effect is not felt on Christmas Island, 530 miles further east. It is pertinent to note that the Cocos-Keeling shearwater also lays there in the last months of the year, and so, in 1941 at least, did the Sooty Tern. In the north-western corner of the Indian Ocean the latter apparently again keeps time with the Noddy, while Betts (1940: 491-2) found *P. lherminieri* present on Aride in some numbers at the end of April, though he was only able to dig out one downy chick and one sitting bird. On the other hand 1,500 miles south-east of the Cocos-Keeling Islands, on Houtman's Abrolhos, off the coast of western Australia, the Sooty Tern and the Lesser Noddy breed from September to January, the months of the southern spring and early summer.

Gygis alba monte Marth.,

White Tern.

Gygis alba monte Mathews, Birds Austr., ii, 1912, p. 443: Seychelles.
Gygis candida, Forbes, 1885, pp. 33-4 and 44; Wood-Jones, 1912, p. 339.

Local name, "*Burong Chuit-chuit*", from the bird's note.

The following twenty-one specimens were retained and are now in the Raffles Museum collection. They were all taken on Pulo Luar (Horsburgh Island).

Coll. No.	Date	Sex	Total Length	Tail	Wing Flat	Tarsus	Bill to Gape	Exposed Culmen
CC7.	14: 1:41	♂	333	113	240	18	53	40
CC9.	14: 1:41	♂	327	115	241	16.5	53	39.5
CC10.	21: 1:41	♂	313	100	232	16.5	55	41
CC12.	17: 2:41	♂	312	109	239	17	52	37
CC14.	17: 2:41	♂	316	105	234	17	51	40
CC15.	17: 2:41	♂	331	102	240	17	55.5	42
CC16.	17: 2:41	♂	322	104	225	17	56	43.5
CC19.	26: 2:41	♂	310	108	234	17.5	54	41
CC20.	26: 2:41	♂	329	120	240	18	55	42
CC21.	26: 2:41	♂	327	110	241	18	55	41.5
CC5.	14: 1:41	♀	316	110	232	14	51	39
CC8.	14: 1:41	♀	321	106	234	17	54.5	41
CC11.	21: 1:41	♀	299	101	238	16	53	39
CC13.	17: 2:41	♀	318	108	238	16.5	55	41
CC17.	17: 2:41	♀	318	117	241	17	50	40
CC18.	26: 2:41	♀	312	98	232	18	53	40

Immature still with some down visible.

CC1.	25:12:40	♂	252	58	136	18	41	28
CC2.	25:12:40	♂	232	48	126	17.5	40.5	28
CC4.	14: 1:41	♂	290	90	191	16	45	32
CC6.	14: 1:41	♂	292	90	208	16.5	46	32
CC3.	25:12:40	♀	274	83	179	18	43	29.25

Soft parts: no apparent difference between the colouring of the male and female birds; iris, dark brown, eyelids, black; bill, black, usually with the base dark blue (in a few birds the base is largely black and

NOTES ON THE BIRDS OF THE COCOS-KEELING ISLANDS

in some there is no indication of the blue colouration; it is possible that the deeper colour is associated with ripening gonads, but it is not possible to say this with certainty on the material collected; legs and feet, in the adult blue-grey with the webs off-white and the claws black.

The White Tern is resident on the Cocos-Keeling Islands throughout the year, occurring on both the main atoll and North Keeling. On the main atoll the birds are largely confined to Pulo Luar, where in 1941 there were 100-300 pairs; there were also 2 or 3 pairs nesting on the west end of Pulo Tikus. The population on North Keeling is probably about the same size as that on Pulo Luar. The birds keep mostly to the less thickly wooded portions of the islands, and do much of their fishing in the lagoons, or very close to the atolls. Occasionally they may be met with over the open sea a few miles away from the group, but they have never been reported at any great distance from the land. Capt. Slocum (1900: 210) claims to have encountered them about 25 miles east of the main atoll and this would seem to be as far as they normally stray away from it (see also Forbes, 1885: 12).

The single egg is usually deposited on the branch of a tree or against the midrib on the horizontal portion of the curving frond of a coconut palm. The trees used most frequently appeared to be the Cocos Ironwood, *Cordia subcordata* Lamm. and the Kayu Sireh, *Tournefortia argentea* Linn., but a few were found on the stumps of dead Papayas, *Carica papaya* Linn. The most favoured sites were 10-25 feet from the ground, and a short distance in from the edge of the island. The egg is an almost perfect oval, with a fine matt surface. The ground colour varies from light fawn to olive. It is variously blotched with dull grey and lilac grey, and above these with scrawls of dark umber and brownish-black the latter markings being mostly in a ring round the broadest portion of the egg. Fifteen eggs, of which five were retained, measured 40-44.5 mm. in length and 30-34 mm. in breadth, with an average of 42.6 x 32.3 mm.

It is possible that these birds lay at all times of the year, as the species is said to do in certain other parts of its range (Murphy, 1936: 1167; Vesey-Fitzgerald, 1941: 529), but on the Cocos-Keeling Islands there is certainly a definite peak period for laying covering the months from May to July, with a recrudescence of laying, or possibly a second brood, from September to November. All the eggs and very young birds that were found fitted in with these two periods, except for an egg seen in March and a 2-week old chick at the beginning of May. Both parents incubate. Two full periods were timed to within 24 hours: they lasted 30-31 and 31-32 days respectively.

The young bird hatches covered with a pre-plumule down. This is smoky grey in colour with a varying amount of biscuit brown at the tips, giving it a mottled appearance which decreases with age as the tips are lost through wear. The earliest feathers to emerge are those along the mid-line of the back and in two small patches one over each scapular region. These appear above the down about the 12th day. The flight and tail feathers emerge soon afterwards. These, together with the long scapular feathers, develop steadily until about the end of the third week. During the 4th and 5th weeks their rate of growth slackens slightly, presumably in consequence of the great development of the covering feathers which takes place at this time. By about the 35th day down is visible only on the forehead, neck, flanks, belly and rump, and in a few fragments adhering to the lesser wing coverts. By the 40th day it is reduced still further to a little on the forehead, throat, lower belly and rump, giving the chick the appearance of being enclosed in a thin smoky haze. A few birds probably begin to fly naturally at this stage, but the majority do not seem to do so far a further 7 to 10 days. By then the down is represented by no more than a few wisps round the throat, over the wing coverts and on the lower belly. These are not lost for some time, and in parts remain on the birds after they have begun to fly. The juvenile plumage is predominantly white, but the upper wing coverts and mantle feathers are richly marked with one or two terminal bars of brownish black bordered with orange rufous, the feathers of the forehead, crown and flanks similarly though less strongly so, and the upper tail coverts faintly so. The young birds also have a small black spot immediately in front of the eye and a rather larger one behind it, joined by a very thin line above the orbit. These become reduced with age and they are relatively much less prominent in birds still with the mottled back and head but with adult measurements.

Gygis alba occurs on suitable, isolated tropical islands in all three oceans, but so far as is at present known there is a break in its distribution in the Australasian region. *G. a. royana* Mathews breeds on Kermadec and Norfolk Islands, and is a possible straggler to the east coast of Australia (Mathews and Iredale, 1921: 105). The next most westerly home of this species is the Cocos-Keeling Islands. Provisionally these birds are here referred to *G. a. monte* Mathews of the western Indian Ocean, which is said to differ from the Pacific forms in having shorter wings, but with the bill as long as in *royana* (Mathews and Iredale, *loc. cit.*). Unfortunately very few precise measurements appear to have been published. Hartert (1927: 19) says that the wing in *monte* from the Seychelles (the type locality) does not as a rule exceed 235 mm. in length, but over half the

NOTES ON THE BIRDS OF THE COCOS-KEELING ISLANDS

adults in the present collection have wing lengths between 238 and 241 mm. Further Mathews and Iredale say that the female in *royana* is smaller than the male, and quote single measurements to support their contention (δ , total length 330 mm., culmen 45 mm., wing 250 mm., tail 110 mm. and tarsus 16 mm.; ♀ , total length 260 mm., culmen 40 mm., wing 243 mm., tail 108 mm. and tarsus 14 mm.). This appreciable difference is not shown in the Cocos-Keeling figures. Possibly these birds are intermediate between the *G. a. monte* of the Seychelles and *royana* of east Australian waters, as at present recorded. They do not, in my opinion, merit a name, but it may well be that a future revision of *Gygis alba*, based on adequate material, will permit the conclusion that one rather variable race extends from the Seychelles eastward at least as far as Norfolk and Kermadec Islands.

Vesey-Fitzgerald (1941: 530) says that the White Tern nests on all the islands and islets of the Seychelles group, and on Poivre, St. Joseph, Remire, Providence, Alphonse and Coetivy in the Amirantes. It is resident in parts at least of the Chagos Archipelago. Peters (1934: 348) says that it also occurs on "some other of the Mascarene Islands", but none of the islands given above are part of the Mascarene group. Alexander (1928: 196) says Madagascar and the Mascarene Islands. In the Seychelles this bird apparently lays all the year round, as another race has been found doing in the Atlantic Ocean. Possibly this also applies to the Amirantes. No adequate data is available for the Chagos group. On the Cocos-Keeling Islands, as noted above, at least the greater part of the laying occurs in the periods May to July and September to November. According to Mathews and Iredale (*loc. cit.*) breeding occurs on Norfolk and Kermadec Islands from October to February. This is more truly in the period of the southern winter than the Cocos-Keeling Islands peak seasons are.

Puffinus pacificus chlororhynchus Lesson.

Wedgetailed Shearwater.

Puffinus chlororhynchus Lesson, *Traité d'Orn.*, livr. 8, 1831, p. 613: no locality specified, type from Shark's Bay, West Australia.

Local name, "*Burong Tanah*"

The following eleven skins were retained. Nos. 1-3 and 11 were taken in the open sea off Pulo Tikus, No. 9 off Pulo Panjang and No. 10 off Pulo Bēras. Nos. 4-8 were taken on North Keeling on 30 January. The specimens marked with an asterisk were sent to the New York Museum of Natural History for identification in April 1947; from an examination

of this material Dr. R. C. Murphy (*in litt.*, 16:1:50) has kindly supplied the provisional diagnosis used in this paper. The remainder are at present in the Raffles Museum.

Coll. No.	Date	Sex	Total Length	Tail	Wing Flat	Tarsus	Bill to Gape	Exposed Culmen
P1.	12: 1:41	♂	435	128	281	48	52	35
P3.	26: 1:41	♂	432	129	285	49	52	38
P5.	30: 1:41	♂	412	124	277	50	51	36
P6.*	30: 1:41	♂	423	123	277	50	49	35
P7.*	30: 1:41	♂	446	134	287	51	55	39
P10.*	12: 6:41	♂	457	132	296	50	54	38
P11.*	28: 9:41	♂	431	131	281	48	53	39
P2.*	12: 1:41	♀	412	124	278	52	56	38
P4.*	30: 1:41	♀	448	136	295	50	53.5	38
P8.*	30: 1:41	♀	433	127	290	51	55	37
P9.*	2: 3:41	♀	431	130	283	49.5	55	37

Soft parts: no apparent difference between the colouring of male and female birds; iris, dark brown; eyelids, black; bill, greyish with a hint of purple, black at the tip and on the turbinate; legs and feet, "corpse-coloured" (a slightly purplish white or a very pale pinkish mauve), with a smoky grey patch along the outer edge.

Wood-Jones (1912: 345) was told that there was a "Mutton Bird" breeding on North Keeling, and he saw the warrens, but failed to find any birds on his one brief visit; he does not appear to have looked for them at sea. The Shearwater is only a breeding visitor to the island. It nests there in considerable numbers, normally laying in October and November. From late August to the end of February it was common over the open water between the islands and the main atoll. Only occasional birds were encountered in the intervening months and we saw no examples during our stay of two days on North Keeling at the beginning of July.

The burrows are excavated in the coarse, sandy soil in the patch of bare ground at the south-east corner of the island. This area is so honeycombed with tunnels that walking over it is difficult and dangerous. The burrow is usually about $2\frac{1}{2}$ – $3\frac{1}{2}$ feet long, and terminates in a small chamber, the floor of which may contain a few fragments of dried grass and covering feathers. A number of old burrows were found in the grassy patch at the north-west corner of the island, but even in January no birds were found near them nor was there any indication that they were still being used.

It seems probable that only one egg is laid. The breeding season was near its finish at the end of January when we paid our first visit to the island, and the majority of the burrows, though obviously inhabited recently, were empty. A few contained solitary, well-developed chicks. A young bird which I took back to the main atoll with me was nearly 295 mm. long,

NOTES ON THE BIRDS OF THE COCOS-KEELING ISLANDS

very plump, with feathers sprouting along the back, well advanced shoulder patches and both coverts and remiges appearing on the wings. It was a placid youngster, but it seemed to miss the comforts of its burrow and, though liberally supplied with food, it died after a few days. According to Serventy & Whittell (1948:94) this species lays in November on the islands off the west coast of Australia, and the young are hatched early in January. This approximates fairly closely to the apparent breeding rhythm on North Keeling.

Demigretta sacra (Gmel.).

Eastern Reef Heron.

Ardea sacra Gmelin, Syst. Nat., i, pt. 2, 1789, p. 640: Tahiti.

Demigretta sacra, Forbes, 1885, pp. 33 and 44.

Demigretta (sic) *sacra*, Wood-Jones, 1912, pp. 342-3.

Local name, "Bēlakok". This name is also used for any other herons, egrets or night-herons visiting the atoll.

The following fifteen skins (Nos. H1-15), taken on various islands on the main atoll, were retained and are now in the Raffles Museum collection. Nos. 14 and 15 are immature birds, not able to fly, taken from nests. The measurements are also given of three birds collected by the present writer on Christmas Island in November 1940. These are marked with an asterisk.

Coll. No.	Date	Sex	Total Length	Tail	Wing Flat	Tarsus	Bill to Gape	Exposed Culmen
H1.	31:12:40	♂	589	99	284	88.5	97.5	79
H4.	7: 1:41	♂	577	97	269	84	98	80
H8.	16: 1:41	♂	592	100	279	82	105	90
H9.	16: 1:41	♂	590+	86+	284	85	100	82
H12.	13: 2:41	♂	564	93	263	84	96	78
H14.	13: 3:41	♂	514	67	229	77	87	65
H15.	18: 3:41	♂	445	60	224	65	80	58
H2.	6: 1:41	♀	570	88	252	81	98	80
H3.	7: 1:41	♀	554	93	273	81.5	97	82
H5.	14: 1:41	♀	558	100	280	77	99	83
H6.	16: 1:41	♀	546	87	271	83.5	97	78
H7.	16: 1:41	♀	555	89	274	83	99	82
H10.	20: 1:41	♀	574	97	277	82	99	83
H11.	4: 2:41	♀	569	96.5	262	77	93	76
H13.	13: 2:41	♀	545	104	262	84	95	77
D30.*	21:11:40	♂	535	88	277	65	91	76
D29.*	21:11:40	♀	591	95	282	77	101	82.5
D28.*	24:11:40	♀	549	87	266	69	91	74

Soft parts: there is some seasonal variation in colouring, the shades being brighter in the breeding months, but no apparent difference between male and female birds; iris, yellow or orange yellow; eyelids, yellowish or yellow, with free border grey; bill, yellowish brown or yellow, greyer at the base of the maxilla and at the tip, with the skin yellowish or chrome yellow at the angle of the gape; legs, grey or yellowish grey; feet, the same with the pads dull or chrome yellow.

This bird is found in small numbers on North Keeling and the majority of the islands in the main atoll. On the latter it nests principally on Pulo Bēlanchi and at the south end of Pulo

Tikus. There are also a few pairs on Pulo Luar and Pulo Panjang. At the south end of the atoll the birds breed in small colonies of about half a dozen pairs in the crests of adjacent coconut palms. In 1941 the population on the main atoll as a whole was about 40 to 50 breeding pairs. Approximately one-third of these were white phased birds and the remainder dark (white 60-65%). The two phases mixed freely and in three instances dark and light birds were found breeding together. Nestlings acquiring their first feathers were found exhibiting both colour patterns.

The nests are broad, rather untidy collections of dead sticks and *Tournefortia* leaves, about 20-25 inches across and 5 inches deep. The material is only loosely worked together, and in the older nests is held in position largely by the guano. The eggs are apparently normally laid between December and February inclusive. Eleven nests were examined of which 7 had clutches of 3 eggs, 3 of 4 and 2 of 2, but in nearly all cases the birds only succeeded in rearing 2 chicks. The egg is a pointed oval in shape with a rough surface and a rather thick shell. The colour is a uniform light glaucous blue, appearing sea-green when viewed from the inside against the light. Twenty-four examples were measured; they ranged from 42-48 mm. in length and 33-36 mm. in breadth, average 46 x 34.5 mm. Details of incubation and fledging are given in an earlier paper (1949: 221-3).

The Eastern Reef Heron is widely distributed in suitable localities from the coasts of south-east Asia south to northern Australia and through the Philippines, Moluccas and the New Guinea islands to the South Pacific. It reaches the western limits of its normal range on the coast of Burma (Smythies, 1940: 460), in the Andaman and Nicobar Islands (Kloss, 1903: 330; Baker, 1929: 352), on the west coast of Sumatra and adjacent islands (Chasen, 1935: 56) and on the Cocos-Keeling Islands. It occurs on Christmas Island, 530 miles further east, but the population there is no more than 15-20 pairs; only one nest has been found, with eggs in August (Gibson-Hill, 1947: 108). Stuart Baker (*loc. cit.*) mentions breeding off the Arakan coast in May, and in the Andamans and Nicobars from the last week in May to August or September, with the peak period from the end of June to July. Madoc (1947: 14) records eggs found on the Malayan coast in May and June. The present writer has MS notes of nests with eggs on islands off Pahang and Trengganu in July and the first week in August. Obviously further dated records of breeding are required from Christmas Island. Nevertheless it is of interest to note that again such evidence as there is from that island suggests a nesting rhythm

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NOTES ON THE BIRDS OF THE COCOS-KEELING ISLANDS

roughly similar to that in the territories further north; while as in the case of two of the terns and the shearwater the data from the Cocos-Keeling Islands show breeding in the period corresponding to the southern summer.

Sula dactylatra bedouti Math. Masked Booby.

Sula dactylatra bedouti Mathews, Austr. Av. Rec., i, 1913, p. 189: Bedout Island, North-west Australia.

(*Sula Abbotti* (sic), Wood-Jones, 1912, pp. 343-4).

Local name, "*Burong Gangsa*", *gangsa* being the Malay term used locally for a goose.

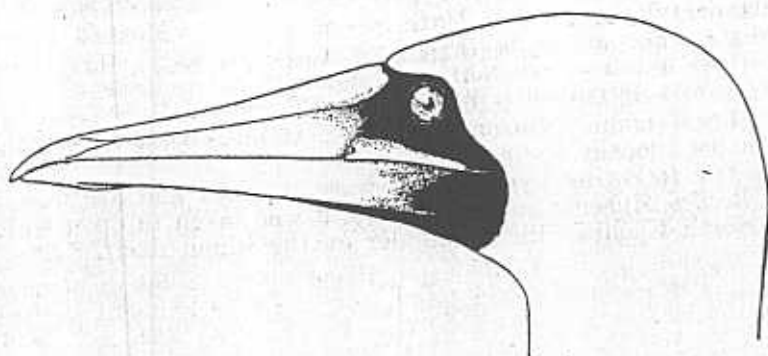
The following twelve skins were retained and are now in the Raffles Museum collection. No. 9 was taken in open water off North Keeling; the remainder on the island itself.

Coll. No.	Date	Sex	Total Length	Tail	Wing Flat	Tarsus	Bill to Gape	Exposed Culmen
G1.	30: 1:41	♂	784	188	425	51	120	97.5
G6.	30: 1:41	♂	805	184	434	53	120	99
G11.	5: 7:41	♂	814	189	427	52	125	104
G12.	5: 7:41	♂	798	193	424	48	123	103
G10.	4: 7:41	♀	861	201	446	53	125	102
<i>Immature birds</i>								
G2.	30: 1:41	♂	785	184	399	52	111	90.5
G4.	30: 1:41	♂	805	165	351	51	123	102
G8.	30: 1:41	♂	760	176	446	52	126	103
G9.	16: 3:41	♂	741	182	452	54	126	106
G3.	30: 1:41	♀	750	165	444	52	126	103
G5.	30: 1:41	♀	820	177	437	53	125	102
G7.	30: 1:41	♀	836	165	439	51	127.5	106

Soft parts: immature birds have much the same soft part colouring as the adult females, but in the younger examples the colours are duller and less intense, the iris is grey, the facial skin grey and the gular skin blue-grey; adults, iris, yellow in the male and yellowish grey in the female; eyelids, facial skin and gular skin, jet black in mature birds of both sexes; bill, yellow, with a hint of greenish grey at the base in the male, and yellowish grey with the base greyer in the female; legs and feet, dull ("earthy") olive in the male, and lead grey in the female.

The only previous record of the Masked Booby's presence on the Cocos-Keeling Islands is Hume's note on a specimen (1877: 310) and Legge's statement (1880: (2): 1181) that "*S. cyanops*" is not uncommon "about the Cocos Islands", but there is no doubt that Wood-Jones's account of *S. abbotti*, cited above, refers to this species. At the present time it breeds only on the island of North Keeling, where it is resident throughout the year. Birds may be met with in adjacent waters at all times, but unlike the smaller boobies it very seldom strays south to the main atoll. The colony on North Keeling is situated on the open ground at the south-east corner of the island, where the prevailing wind strikes it. In 1941 it contained about 40-50 breeding pairs. On 30 January we found 7 active nests, 3 with eggs and the remainder with single, half-downy chicks.

In July there was a total of 32 active nests, all containing eggs. The reproductive cycle, from the appearance of the first egg to the departure of the chick, takes about 22-24 weeks; the normal period for laying must, therefore, be in and about June.



Head of a male Masked Booby, *Sula dactylatra bedouti* Math., taken on the island of North Keeling.

No real nest is built. The eggs are laid in a shallow circular depression, about 12 inches in diameter and perhaps 2 inches in depth, in the sandy ground. In most cases a number of small, bleached fragments of coral are trodden into the depressions, forming a slight lining. In one nest there were over 20 of these pebbles and in another 18. A few also had short lengths of twig. Round the depression is a ring of bare soil, about 9 inches wide, from which everything but the toughest grass roots is soon plucked by the sitting bird. The surface of the soil itself is generally finely but shallowly pitted, as though the bird pecked at it repeatedly. Such guano as is ejected usually lies beyond the edge of the ring (see plate 6). It seems probable that some of the pebbles found in the nest are ones that have been presented to the female by the male during courtship. The others are almost certainly tidied into the depression by the sitting bird, and no doubt the occasional twigs reach it in the same way.

A normal clutch consists of two eggs. They are roughly ovoid in shape, with a fairly thick shell. The latter is a light, watery blue in colour, but is usually completely obscured by a covering of lime. Ten eggs of which 5 were retained, ranged from 66.5-69 mm. in length and 43-45 mm. in breadth. Few of the birds were found to be sitting on their eggs when the nests were first approached. Those that were, appeared to hold them under the great webs of their feet. The remainder were standing close by them so that the eggs were shaded by their bodies,

but not actually covered. When these birds were approached they waddled to the eggs and proceeded to tuck them in under the feathers of their breasts, lowering themselves as they did so into a sitting posture, with their wings held loosely a little away from their flanks. In this position they showed their anxiety by slowly nodding their heads and striking downwards, first to one side and then to the other, with half open bills. They made no further move, and no sound, unless one approached much closer. Then, usually after emptying their stomachs (carefully ejecting the fish outside the neat, bare ring), they launched into a typical booby attack. The noise made on these occasions differs with the sex of the bird. In the male it is a shrill hiss which almost becomes a whistle. In the female it is a great trumpeting quack, full of righteous indignation and bravado.

In spite of their two eggs the North Keeling birds apparently rear only one youngster to each nest. No freshly hatched chicks were seen, but presumably they are at first completely naked. The down (pre-plumule) is thick, moderately long and pure white in colour. The earliest feathers to appear are the scapulars, rectrices and remiges. The upper tail coverts and the greater wing coverts follow shortly afterwards. The immature bird No. G4 above, with a total length in the flesh of 805 mm., is well covered with a thick white down except in these regions. The coverts at the angle of the wing and on the sides of the shoulders have also emerged from the skin, but they are still under the down. In the first juvenile plumage, No. G8 above, the breast, belly and under tail-coverts are white. The under wing-coverts are white with darker feathers along the leading edge and among the coverts at the base of the outer primaries. The rectrices and remiges are a dark, slightly greyish brown. The head, neck, upper wing-coverts and rump are the same colour. The back is slightly paler, with the tips of the feathers lighter, almost buff; these give it an uneven appearance. The feathers at the base of the hind neck and on the sides of the rump are white with greyish brown centres, forming a mottled collar round the posterior part of the neck. The dividing line between the fore-neck and the breast is clearly defined, but it is placed appreciably further forward than it is in the adult Brown Booby, where it cuts through the middle of the breast. This is a good distinguishing point in standing birds, but not of much help when they are on the wing. At such times the diagnostic features are the pale collar, the slightly mottled back, the irregular merging of the colours on the flank, and the untidy finish to the white bar along the under surface of the wing. In the adult Brown Booby the latter forms a clearcut panel, widest at its base and gradually tapering towards the wrist. In the immature Masked Booby it is narrowed by the mottling on the

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leading edge of the wing and forms a dog-legged band of almost equal width as far as the wrist, where there is a large crescent-shaped white area covering the base of the inner primaries. The next stage, No. G5 above, has more white on the under wing; the white band extending forward to the leading edge except at the base of the first two primaries. The feathers of the head and neck are rather greyer, and each has the base and a fine fringe at the tip white; this gives these areas a faintly mottled appearance which is most marked on the chin and foreneck. The feathers of the rump are largely white, with the distal two-thirds of some of them brownish grey. The collar region is almost pure white with very little mottling. The sides of the rump are the same. The scapular feathers have broader whitish tips than in the previous stage. The lesser and medium coverts are similarly marked. The general effect is of a much paler bird, markedly mottled on the dorsal surface and finely speckled on the head and neck. The white collar and the light rump should be diagnostic.

The race *bedouti*, which is doubtfully distinct from *S. d. personata* Gould² of the central and western Pacific and north-eastern Australia, here reaches its most westerly known breeding point. Two Masked Boobies were seen, but not collected, by the present writer on the island of Pulau Perak, in the northern portion of the Malacca Strait in April 1949 (see Gibson-Hill, 1950: 2); they may have belonged to this race, or to *S. d. melanops* Heuglin, which occurs in the western Indian Ocean. Mathews records *bedouti* from Christmas Island, and in this is followed by Peters (1931: 84), but it seems certain that this is an erroneous localisation; the latter island is certainly not suitable for it. The range of *bedouti* as at present established should be taken as north-western Australia (Mathews and Iredale, 1921: 75), the Banda Sea (van Bemmelen and Hoogerwerf, 1940: 446-50) and the Cocos-Keeling Islands.

Sula leucogaster plotus (Forst.).

Brown Booby.

Pelecanus Plotus Forster, Descr. Anim. ed. Licht., 1944, p. 278: near New Caledonia.

Sula sula, Wood-Jones, 1912: p. 343.

Local name, "*Burong Bebek*", *bebek* being the Malay term used locally for a duck; cf "*Kaki Bebek*", the large flat starfish.

2. *S. d. bedouti* is characterised by its author (Mathews, 1913: 189) as "Differs from *S. d. personata* Gould in its much smaller size, especially in the bill; and in having blue feet". No measurements are given and though the name is accepted provisionally here, it seems to the present writer that the characteristics given are of little significance as the author presents them. Soft part colouration can be very variable among the boobies (vide *Sula sula rubripes* here), and slight differences of size have little meaning if single birds or very small series are being compared.

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NOTES ON THE BIRDS OF THE COCOS-KEELING ISLANDS

The following ten skins were retained. Nos. 13, 14, 19 and 22 were taken at sea off Pulo Tikus, No. 21 off North Keeling and No. 20 five miles north of Pulo Luar. The remainder, Nos. 15 to 18, were taken on North Keeling itself.

Coll. No.	Date	Sex	Total Length	Tail	Wing Flat	Tarsus	Bill to Gape	Exposed Culmen
L13.	19: 1:41	♂	761	209	392	42	120	101
L15.	30: 1:41	♂	764	207	396	43	116.5	97
L17.	30: 1:41	♂	804	208	398	42	118	101
L18.	30: 1:41	♂	760	210	398	41	117.5	98
L21.	16: 3:41	♂	731	198	392	43	115	96
L14.	22: 1:41	♀	800	211	406	44	125	103
L16.	30: 1:41	♀	838	227	423	45	130	107
L19.	1: 3:41	♀	821	222	426	45	126	102
L20.	13: 3:41	♀	804	204	415	45.5	125.5	104
<i>Immature bird</i>								
L22.	24: 9:41	♂	734+	184+	411	42	117.5	94

Soft parts: there is a difference in the colouring of these areas in adult male and female birds,³ iris, grey in both sexes; eyelids, dull blue; facial, ramal and gular skins dull dark purple in the male and light greenish yellow in the female, often with a slightly darker patch in front of and below the eye; bill, light greenish grey in the male, and slightly paler with the tip almost white in the female; legs and feet, pale arsenic green in the male and pale yellowish green in the female.

In the present group this bird breeds only on the island of North Keeling, nesting on the ground, mostly close to the fringe of the *Tournefortia* belt, on the east and south sides of the island. It is apparently strictly resident but individuals stray rather more widely than those of the preceding species and were seen in the neighbourhood of the main atoll on a number of occasions. The colony is a small one and in 1941 there were only about 75-100 breeding pairs. It would seem that, as on Christmas Island, these birds have no unanimous breeding season, though there is probably a peak period for egg laying which cannot be placed on the meagre details available. The nesting habits do not differ appreciably from those already recorded by the present writer (1947: 109-115; 1949: 223-226). Ten eggs collected on North Keeling ranged from 51-63 mm. in length and 36.5-44 mm. in breadth.

The plumages of the immature birds follow the same general pattern as that of the adult. In the first juvenile the areas which will ultimately be dark chocolate are a uniform dark

3. In both cases these are virtually the same as the colours recorded on Christmas Island (Gibson-Hill, 1947: 111-2). The immature bird, No. L22 above, had:—iris, grey; bill, pale grey-blue; gular and facial skin, dark grey blue; legs and feet, light orange-pink.

greyish brown. The head, neck, back and dorsal surface of the wings are all concolourous. The shade is about the same as that of the back (the darkest portion) of the first juvenile plumage in the Cocos-Keeling *S. s. rubripes*. The remiges are a dark, hoary brownish black. The remiges are the same colour as the back, with the shafts dark throughout their length, not whitish on the proximal half as they are in the young *rubripes*. The under parts that will ultimately be white, including the axillary feathers and the long bar under the wing, are initially a pale, dirty grey. The bill is a pale grey-blue, with the gular and facial skin a dark grey-blue and the feet a light orange-pink. This plumage is succeeded by a stage with the upper parts rather darker, and the under parts paler, or mottled with white and pale grey feathers. At this stage the legs and feet are usually lemon yellow, sometimes with a hint of green or greenish yellow, the bill is a light greenish grey, and the facial, inter-ramal and gular skins dull purplish grey in a young male and greenish grey in a young female.

The Brown Booby is widely distributed on small blue-water islands through the tropical portions of all three oceans. Part of this range is of interest here. According to Archer and Godman (1937 (1): 23-4) it nests on several islands in the Red Sea and off the Somali coast. Vesey-Fitzgerald (1941: 521) reports it in small numbers from the Seychelles. Baker (1929: 285) says that there are few records from the Indian region, and it has only been taken once in the Laccadives. This suggests a blank belt east of the Seychelles. It is fairly numerous in the Mergui Archipelago and through the central waters of the Malacca Strait south to Singapore (Chasen, 1933: 68). Robinson (in Robinson & Chasen, 1936: 242) says that it breeds on a small rocky islet in the Aroa group in the middle of the Strait. The present writer (1950:) found a large colony containing 5,000-6,000 adults on Pulau Perak, seventy miles west of Penang Island, in April 1949; breeding was apparently finishing for the year. It also nests on Christmas Island (Indian Ocean), where in 1938-40 there were approximately 5,000-6,500 breeding pairs. Further east *leucogaster* occurs widely at suitable points in the Austro-Malayan region and out across the Pacific. On the evidence available at present the subspecies *plotus* (Forster) seems to run from the western and central Pacific westwards, possibly as far as the African coast. Attempts have been made to split this race, but several difficulties arise, including the apparently irregular distribution of what might be valid characters. Mathews (1913: 189) tries to isolate the birds from Western Australia as *rogersi* (type locality Bedout Island), on the grounds of their "having silver-grey eyes

and Pale blue feet".⁴ Later he tired of this pretty nonsense and *rogersi*, like a number of his youthful indiscretions, is treated as not proven in his last List of Australian birds (1946: 14). Unfortunately in the interval Chasen (1933: 67) has used it, with a query, for Tweedie's birds from Christmas Island, and Peters (1931: 85) lists it dubiously with the range "Java to northern Australia"; this last entry also gives the erroneous impression that *leucogaster* does not occur in the western Indian Ocean. Birds from Christmas Island and North Keeling appear to be identical. They are here referred to *plotus*. A revision based on a consideration of an adequate amount of material from a wide area might result in further division of this species, but if this occurs it seems to the present writer that it is more likely to be the birds from north of the Sunda Islands, and possibly those from the extreme north-west of the Indian Ocean, that will need a new name, or names. As Chasen (*loc. cit.*) points out, the skins in the Raffles Museum collection from Christmas Island (to which must now be added these from the Cocos-Keeling group) differ slightly from six examples from the Malacca Strait. In the latter the bill is appreciably smaller and less robust, while the head and neck are nearly concolourous with the back and wings. Fully mature adults from both Christmas Island and North Keeling have the head and neck noticeably darker than the back and upper-wing coverts. In fresh skins these areas are almost black, and the same shade as the remiges; while the rectrices are a little paler, and about the same colour as the remaining upper parts.

Sula sula rubripes Gould.

Redfooted Booby.

Sula rubripes Gould, Synops. Birds Austr. pt. iv, 1838, App. p. 7: Australia.

Sula piscatrix, Forbes, 1885, pp. 32 and 44; Wood-Jones, 1912, p. 344.

Local names, "*Burong Puteh*" for the adults and "*Burong Main-main*", "*Burong Bureh*" and "*Burong Bělorek*" for the juveniles. *Main-main*, meaning to play about, is given to the first plumage birds because of their irregular, questing flight and their particular casual interest in any small boats fishing near where they are congregated. *Bureh* and *Bělorek* are different words signifying patterns of mottling and refer to the uneven brown plumage and later the definitely spotted plumage of the intermediate stages.

4. This bird is figured with blue feet in Mathews's *Birds of Australia* (1915: pl. 228), but in the text the feet are described as pale yellow! cf. *S. dactylatra bedouti*.

The following twenty-five skins were retained and are now in the Raffles Museum collection. The majority of these were taken in open water off the main atoll. Nos. 7-14 were taken on North Keeling on 30 January.

Coll. No.	Date	Sex	Total Length	Tail	Wing Flat	Tarsus	Bill to Gape	Exposed Culmen
S3.	12: 1:41	♂	713	226	391	37	106	88
S4.	12: 1:41	♂	700	224	371	38	102	84
S6.	26: 1:41	♂	710	207	395	37	104	85
S7.	30: 1:41	♂	682	183	375	38	103	84
S10.	30: 1:41	♂	730	229	389	39	100	83
S11.	30: 1:41	♂	728	233	385	39	101	81
S13.	30: 1:41	♂	716	232	370	38	107	90
S14.	30: 1:41	♂	712	210	380	39	102	86
S15.	28: 2:41	♂	707	218	356	40	103	87
S16.	1: 3:41	♂	692	212	365	37	103	86
S17.	2: 3:41	♂	691	204	358	38	100	84.5
S19.	5: 3:41	♂	681	205	376	41	102	83
S21.	13: 3:41	♂	728	220	374	39	105	85
S24.	23: 3:41	♂	711	224	388	39	103	86
S25.	8:11:41	♂	671	187	377	39	104.5	85
S8.	30: 1:41	♀	710	207	370	39	104.5	84.5
S9.	30: 1:41	♀	715	219	396	40	106	90
S18.	5: 3:41	♀	694	208	377	38.5	101	85
S20.	11: 3:41	♀	684	177	387	40	102	85
S23.	16: 3:41	♀	681	204	376	39	102	85
S22.	16: 3:41	♀	754	217	370	40	110	94
<i>Immature birds</i>								
S1.	12: 1:41	♀	671	205	379	35	104	84
S2.	12: 1:41	♀	669	183	358	37	105	87
S5.	19: 1:41	♀	721	208	406	39	105	89
S12.	30: 1:41	♀	698	193	394	39	102	84

Soft parts: the colouring varies markedly with age, but there does not appear to be any difference between the male and female birds; iris, grey in young juveniles, putty grey in intermediate birds and dark brown in the adults; eyelids, facial, ramal and gular skin purple in young birds with a pale patch on one or both lids; in the adult the eyelids are bright light green and prussian blue, with the free border blue, the mandibular skin green (or green and orange pink, in breeding birds), an orange pink line across the forehead and the gular skin jet black; bill, black in very young birds, and light bluish green in adults, with the base of the mandible greener in breeding birds; legs and feet, pinkish buff in young birds, salmon pink in intermediate ones and a full rich crimson madder in breeding adults. It will be noted that the colouration of the soft parts in the young birds is very similar to those recorded on Christmas Island, but in the breeding adult the colour of the bill and facial skin is markedly different,⁵ and this in spite of the fact that Redfooted Boobies can be encountered over open water half-way between the two islands. It was not possible to determine whether or not the black ramal skin was associated, as on Christmas Island, with ripening or ripe gonads.

⁵. This definitely atypical colouring approaches that recorded by Beebe (1924: 320) for breeding birds on Tower Island in the Galapagos group.

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The Redfooted Booby is resident on the Cocos-Keeling Islands, and though birds may be met with at distances up to 200-250 miles from the atolls there is no indication of an appreciable seasonal variation in numbers. Further it was noticeable that the intermediate birds, in various stages between the immature and the fully adult plumage, were present at all times. As is shown above they were sufficiently noticeable for the Malays to have recognised two parti-coloured dresses and given them particular names (*Bureh* and *Bēlorek*). This is in marked contrast to Christmas Island where adults were again apparently present in undiminished numbers all through the year, but intermediate birds were very rarely seen and juveniles were scarce except in the last four months of the year, immediately following the nesting season. It may be, of course, that the stocks on the two islands are sufficiently distinct for the intermediate stages to be suppressed on Christmas Island and present on the Cocos-Keeling Islands. There is no doubt that the length of time for which a parti-coloured plumage is maintained in the boobies varies. On a number of islands including South Trinidad, the Galapagos group, parts of the West Indies, the Marquesas, the Revilla Gigedo group and Mauritius, some individuals of *rubripes* actually nest in a brown and white plumage (Murphy, 1936 (2): 863-5; see also Alexander, 1928: plate 74, fig. 1). Moreau (1940: 52-3) shows that about one-third of the Masked Boobies, on Latham Island, about 40 miles south-east of Zanzibar, breed while still in an immature plumage. There was no indication of this occurring with *rubripes* on either Christmas or the Cocos-Keeling Islands, though such birds were plentiful on the latter.

Earlier records show that this, the only tree-nesting booby occurring on the Cocos-Keeling Islands, bred in considerable numbers at the south end of the main atoll in the early days of the settlement (Keating, in Holman, 1846: 381; Darwin, 1845: 542; and Forbes, 1885: 33). As the last author rather naively puts it, they were driven away "by the constant interruption from the nut-gatherers", that is by the Malays taking eggs and sitting birds for food. At the present time *rubripes*, like the other boobies and frigate-birds, breeds only on the island of North Keeling. It is the most plentiful of the species there; in 1941 there were 3,500-4,000 active pairs. The great majority of the birds nest in the *Tournefortia* trees. They occur in this region all round the atoll except along the west side. There are also a small number in the tops of the *Pisonia* trees on the points known as Pulo Latim and Pulo Bill. Finally a few pairs nest among the colonies of frigate-birds in the two big clumps of *Pemphis*. It is interesting to note that although the frigate-birds obtain much of their food by robbing homeward bound

boobies off the shores of the island, they do not molest them unduly at their nests. On Christmas Island again one often saw one or two pairs of the Redfooted Booby breeding in trees containing small colonies of *F. andrewsi* (see also Vesey-Fitzgerald, 1941: 522; and Murphy, 1936: (2): 866).

Such observations as were possible indicate that the nesting habits of this bird on North Keeling do not differ materially from those recorded by the present writer for Christmas Island (1947: 115-119; and 1949: 226-228). The data collected on my two visits suggest that the majority of the birds lay between April and the beginning of June. In 1941 a very small number had begun as early as the end of January; while a few must have laid rather later in the previous year, as there were several juveniles about with fragments of down still adhering to the head and neck. On Christmas Island the nests are normally built from the middle of April to the beginning of June, and the eggs mostly laid between the last week in May and the end of June. The majority of the young birds start to fly in October and November. In two years I found no nests far outside these limits. It would thus appear that the season is adhered to more rigidly on Christmas Island than it is on the Cocos-Keeling Islands, and that in general the birds on the latter begin rather earlier. Mathews and Iredale (1921: 74) give May and July to September for the breeding season on the Queensland coast. Vesey-Fitzgerald (*loc. cit.*) says that it is found about September in the Seychelles.

There is only one egg to a clutch. Ten eggs measured on North Keeling ranged from 56-62 mm. in length, and 37.5-40 mm. in breadth, average 58.8×38.3 mm. These figures are not materially different from those obtained on Christmas Island. Newly hatched birds are naked. The skin is a dull lead grey with the face and bill much darker. In older chicks these areas are almost black. The down (pre-plumule) is ultimately long, of a fine texture and pure white in colour. The first immature plumage is a fairly uniform dark greyish brown, with the head and neck slightly paler, and the throat and middle of the belly appreciably paler. The colour of the back is about the same shade as in the immature *S. leucogaster*. The remiges are a dark, hoary brownish black, and the rectrices dark brown; the latter have the proximal half of the shafts white, while in *leucogaster* they are dark throughout their length. The iris is grey with the free border pinkish, the eyelids are purple, the bill black, and the feet pinkish buff. A few birds were observed on North Keeling with something of this general colouring, but the tail, rump, lower belly and flanks pure white, and the head, neck, breast and belly a uniform fawn grey. These birds had almost attained the fully adult colouring in the soft parts, but

the irides were still greyish brown, the bill pale purplish grey not bluish green, and the legs and feet dull madder (No. S10). The normal succession to the first juvenile plumage is for the under tail-coverts, belly and breast to be white, and the foreneck and throat a very light grey brown (No. S15). The feathers of the back and the wing coverts are then edged with white. The feathers of the head, face and hind neck are slightly paler than in very young birds, with white edges, broadest on the hind neck. The general effect is not unlike that of an immature brown booby except that the colouring is paler, there is no hard boundary between dark and light areas on the breast, and the under wing is a pale, hoary grey-brown not white. Birds at this stage have the iris grey brown, eyelids and facial skin bluish, the gular skin grey-purple, and the bill a pale grey-purple, darkening almost to black at the tip. The feet are a pale salmon pink. More nearly mature birds (Nos. S7 and 16) show an increasing amount of white on the feathers of the back, a mottling of white on the lesser and medium wing coverts, and the whole head, neck and underparts white, except for the flank and under wing-coverts, where white feathers are mixed in with the grey brown ones. The soft parts at this stage show the iris putty grey, eyelids blue-grey, and gular skin grey and the bill a very light pinkish grey with the tip grey-brown. The legs and feet are salmon pink, with the claws off-white. While moulting to the adult plumage young birds for a time have the coverts above and below the wing largely white with only a few grey brown feathers amongst them, the back the same and the tertiaries and mantle feathers white, or grey-brown with white tips (No. S8). The darker colouring remains longest on the rump; this is in contrast to *S. dactylatra* where the rump begins to lighten before the mantle and back. Both upper and under tail-coverts are white. The tail contains a varying number of white feathers, or feathers that are white with faint hoary grey-brown markings on the proximal portion of one or both webs. The eyelids are light blue, with the free border darker, the facial and gular skins pinkish grey, and the bill light blue with the tip grey. The feet are still salmon pink. This colouring is not grossly dissimilar from that of the soft parts of a non-breeding adult, in full white plumage, on Christmas Island, except that in the adult bird the iris is dark brown, not putty grey. The remaining soft parts in the Christmas Island birds are:—upper eyelid dull blue; lower eyelid pinkish; bill pale blue, slightly washed with pearl grey at the tip and pink round the base; the line of bare skin over the forehead and round the gape pink; inter-ramal skin blue grey, with a hint of mauve; and the legs and feet madder rose, washed lightly with orange on the legs (1947: 116).

The Redfooted Booby is found in the tropical portions of all three oceans, but its distribution is limited by its need for isolated islands where there are trees or bushes for it to nest in. As Murphy (1936 (2): 865-6) shows there is only one report of its building anywhere other than in woody vegetation. This is given in a statement by Hanna (1926: 65) that on an island in the Revilla Gigedo group the birds nest chiefly in the grassy areas where they construct a platform of grass stems 1-2 feet in height. At the present time two subspecies are recognised, the typical race occurring in the Atlantic, and *rubripes* covering the Pacific and Indian Oceans and their adjacent seas. Various attempts have been made to split the latter, and even one to divide the species as a whole by separating off all the birds that breed in a parti-coloured or brown plumage (Grant and Mackworth-Praed, 1933: 118-9). None of the revisions suggested so far seems to be satisfactory. *Rubripes* as it stands is known from the majority of the suitable islands in the north-western part of the Indian Ocean, but not from the Red Sea area (Archer and Godman, 1937), the islands off the east coast of Africa (Moreau, 1940) or as a breeding bird from the Bay of Bengal (Baker, 1929: 287). East of the Cocos-Keeling Islands it has been found nesting on Christmas Island, Gunong Api in the Banda Sea and islands off the coast of Queensland. I have not had an opportunity of examining specimens from any additional localities other than Christmas Island. Birds from this island are similar to those on the Cocos-Keeling Islands except for the points noted above, the colouring of the soft parts in the adult, and the apparently additional juvenile and intermediate stages exhibited by the birds on North Keeling. A comparison of the dates of the breeding seasons has already been made.

Fregata ariel subsp.

Least Frigate-bird.

Atagen Ariel G. R. Gray; List. Gen. Birds, iii, 1845, p. 669, pl. 183: Raine Island, North Queensland.

Tachypetes minor, Forbes, 1885, pp. 32-33 and 44.

Fregata ariel, Wood-Jones, 1912, p. 343.

Local names, "*Burong Kiling*" and "*Katek*". *Burong Kiling* is used for both frigate-birds, at all ages. *Katek*, a Javanese word meaning pygmy or dwarfed, is applied only to this species, either by itself or as a qualifying adjective.

The following twenty-four specimens were retained. Those marked with an asterisk were sent to the New York Museum of Natural History in April 1947 for comparison with material there in an attempt to determine the subspecific status of these birds. The remainder are still in the Raffles Museum. Nos. 1, 2, 30 and 31 were taken over the lagoon off Pulo Selma, Nos. 8-11 and 32 were taken off Pulo Tikus and Nos. 4-7 and 39

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Adults.

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F39.* 2
F4. 2
F32. 1
F33. 1
F35. 1
F36. 1

Immature

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NOTES ON THE BIRDS OF THE COCOS-KEELING ISLANDS

off Pulo Luar, all in the main atoll. Nos. 27 and 54-56 were taken on the island of North Keeling, and the remainder over the open sea near to it.

Adults.

Coll. No.	Date	Sex	Total Length	Tail	Wing Flat	Tarsus	Bill to Gape	Exposed Culmen
F34.*	16: 3:41	♂	725	320	544	22	96.5	79
F37.*	16: 3:41	♂	712	308	518	23.5	101.5	85
F38.*	16: 3:41	♂	734	307	522	23.5	98	80
F39.*	23: 3:41	♂	772	331	550	22	103	85
F4.	22: 1:41	♀	750	316	562	25	109	91
F32.	16: 3:41	♀	751	319	549	25	106	86
F33.	16: 3:41	♀	771	319	541	25.5	110	90
F35.	16: 3:41	♀	795	324	549	24	113	93
F36.	16: 3:41	♀	762	314	534	25	109	87

Immature birds (heads sandy rufous or lighter)

F1.	9: 1:41	♂	653	244	535	22	101.5	84
F6.	22: 1:41	♂	700	285	535	23	99	83
F8.	22: 1:41	♂	725	314	555	23	102	82
F10.	22: 1:41	♂	732	297	529	22	101	85
F11.	22: 1:41	♂	724	304	532	23	99	80
F31.	28: 2:41	♂	730	304	530	24.5	102	83
F2.	9: 1:41	♀	775	321	524	24	109	90.5
F5.	22: 1:41	♀	784	337	566	24	106	88
F7.	22: 1:41	♀	794	342	581	24	109	90
F9.	22: 1:41	♀	750	312	554	24	106	87
F27.	30: 1:41	♀	735	278	491	25	109.5	88
F30.	20: 2:41	♀	758	314	562	24	105	87

Three nestlings largely in down

F54.	5: 7:41		354	—	61	22	68	52
F55.	5: 7:41		395	—	70	25	83	61
F56.	5: 7:41		375	—	83	24	81	60

Soft parts: the colouring of the soft parts differs with age and sex except that the irides are always dark brown; adult *males* have the eyelids black, the bill black, sometimes greyish at the tip, the gular skin a rich orange-vermillion, brighter and darker in breeding birds, and the legs and feet black with the pads pinkish yellow; slightly younger males (No. F.39) have the bill dark slate-grey and the gular skin dull vermillion; adolescent males (No. F.38) have the bill a very light pinkish mauve, the gular skin a light madder grey and the legs and feet a very pale mauve, with a suggestion of a smoky wash on the dorsal surface of the feet; first juvenile plumage males have the eyelids light blue, greyish or black at the free border, bill light blue, sometimes with the base of the mandible washed with pale mauve, the gular skin light blue or pale grey, the legs and feet off-white or a pale smoky pink; adult *females* have the eyelids a deep salmon pink, the bill salmon pink, sometimes paler at the tip, the gular skin salmon pink tinged slightly with smoky grey, and the legs and feet salmon pink or a yellowish pink washed with salmon pink on the dorsal surface of the outer two digits; slightly younger females (No. F.2) have the eyelids mauve pink, with a light blue patch on the lower lid, the bill mauve pink, the gular skin smoky pink and the legs and feet whitish pink; adolescent females (Nos. F.7 and 9) have the eyelids light blue with the free border grey, the bill a light mauve grey, the gular skin a light grey blue and the legs and feet off-white; first juvenile

plumage females have the eyelids, bill and gular skin all light blue, and the legs and feet a very light blue (this is very close to the colouring of some of the first juvenile plumage males); nestlings (Nos. 54-6) have the eyelids, gular skin, legs and feet a very light blue, and the bill very light blue, slightly pinkish towards the tip with the end grey.

Formerly at least one species of frigate-bird was nesting on the Cocos-Keeling Islands in the great clumps of *Pemphis* at the south end of the main atoll (Darwin, 1845: Chap. 20), but the birds had moved away long before Forbes's visit in 1879 (1885: 32-3). At the present time this species and the next are resident only on the isolated island of North Keeling, where they still breed in considerable numbers. Juveniles frequently fly over to the main atoll in search of food, but the adults stray less and are seldom seen there.

In 1941 there were 750-1,000 pairs of the Least Frigate-bird breeding on North Keeling. They nest in two closely packed colonies in the areas of *Pemphis acidula* at the south-east and north-east corners of the island, in company with the next species. No active nests were discovered on our January visit, but in July nearly all contained a single egg or a young chick. Only a very small proportion of the males had inflated gular pouches. From a consideration of the length of the breeding cycle in allied species it would seem that the normal period for laying must be between early May and the beginning of July. A fuller description of these colonies has already been published by the present writer (1948: 83-7). Ten eggs measured on North Keeling, of which 5 were retained, ranged from 58-61 mm. in length and 40-43 mm. in breadth, average 59.2×41.1 mm. Stuart Baker (1929: 298) records an egg 60.1×43.1 mm. taken by Wood-Jones on North Keeling on 10 June.

The smallest chicks seen were completely naked, with the skin a pale blue-grey, almost white, and the bill, legs and feet white, with the claws dark horn grey. Slightly larger youngsters had a thick covering of long, fine, pre-plumule down. Apart from the pale colouring of the bill and facial skin they bore a superficial resemblance to the young of *Sula sula*, but the subsequent development of the down, which at this stage is still preparing to break through the skin in full force, is markedly different. In the boobies the whole chick becomes covered with a long, white fluff before the earliest feathers (in the order rectrices, remiges, scapulars) appear. In the frigate-birds the mantle feathers (in four patches, one over each shoulder and one on each side of the midline) begin to thrust through almost as soon as the down. As a result the young frigate-bird is never entirely covered with down alone. A chick 196 mm. long which I examined had scapular feathers of 10 mm., of which

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about half was beyond the end of the sheath. In a larger chick, just under 300 mm. in length, the shoulder feathers were over 75 mm. long.

Three larger chicks, Nos. F.54-56 above, were retained. They are thickly covered with a long, white, plumule down, with feathers (pale sandy rufous in colour) well developed on the fore part of the head. The scapular patches have also progressed considerably, and the longest plumes are about 115 mm. in length. They are a very dark brownish black, with the shorter median feathers slightly paler and with still paler tips. The greater coverts, which in the frigate-birds precede the remiges, have also appeared, the longest, over the outer secondaries, being about 54 mm. There is a small puff of grey down in the coccygeal region, but no feathers are through the skin in this area. The eyelids, legs and feet are a very light blue, and the bill mostly the same colour but slightly pinkish towards the tip and with the tip itself grey.

The juveniles collected in January show only one plumage pattern, which is the same in both sexes. The head and neck, together with a median patch on the breast, are sandy rufous, the colour paler and creamier on the forehead and in some cases on the nape. The remiges, rectrices and rump feathers are a very dark brownish black with black shafts. The long scapular feathers are the same, but the shorter scapulars and the feathers of the back are dark brown, blackish towards their centres and drab towards their tips. The upper wing-coverts are dark brown, with the feathers lying along a diagonal bar from the wrist to the elbow broadly edged with ivory white. The under tail-coverts are black, the belly and lower flanks white, and the breast dark brownish black. The under wing-coverts are black.

The subspecific status of this bird, like that of the next species and the Cocos-Keeling shearwater, has not yet been determined. The only comparative material available in the Raffles Museum collection is specimens of *Fregata a. ariel* (G. R. Gray), the typical race, from the waters off the Malay Peninsula. This bird breeds in the South Pacific, and at intervals through the Moluccas to the South China Sea. It also occurs along the north Australian coast to north-Western Australia. The Cocos-Keeling birds appear to be clearly distinct from it. The only other accepted race of the Least Frigate-bird known from the Indian Ocean is *Fregata ariel iredalei* Mathews, which breeds on Aldabra and the Cosmoledo atoll (Betts, 1940: 500; Vesey-Fitzgerald, 1941: 530), and at the south end of Mahlosmadulu in the Maldives (Gardiner, 1903: 369); Gardiner found young birds nearly fledged, but no eggs, in the last locality on 13 November. Unfortunately no examples of *iredalei* are available to me, but the specimens collected on North Keeling are clearly

too large to be covered by the definition given by Mathews (1914: 121) when he described *iredalei*. He writes "from the Mascarene group a subspecies can be recognised with a very small bill, the longest female bill being 80 mm., the longest wing 542 mm." No other details are given. The shortest female bill, adult or immature, in the North Keeling series is 86 mm. along the exposed culmen, with ranges of 86-93 mm. for five adult birds and 87-90.5 mm. for six juveniles. The wing measured flat in the adult females from North Keeling ranges from 534-562 mm., with an average of 547 mm., 5 mm. above Mathews's stipulated maximum for *iredalei*.

Fregata minor subsp.

Lesser Frigate-Bird.

Pelecanus minor Gmelin, Syst. Nat. i, pt. 2, 1789, p. 572: Christmas Island, Indian Ocean.

Fregata aquila, Wood-Jones, 1912, p. 343.

Local names, "*Burong Kiling*" is used for this bird in common with the preceding species. The specific terms are "*Burong Patok Puteh*" (the whitebilled bird) for juveniles, "*Wagus*" for adult males and "*Babun*" for adult females.

The following thirty-four specimens were retained. Those marked with an asterisk were sent to the New York Museum of Natural History in April 1947, in the hope that the authorities might be able to pronounce on the subspecific status of the Cocos-Keeling birds. The remainder are still in the Raffles Museum. This bird is more numerous than the preceding species on North Keeling, but individuals visit the main atoll less frequently. Nos. F.3 and F.28 were taken off Pulo Selma, Nos. F.12 and F.13 off Pulo Tikus and No. F.29 off Pulo Luar. The remaining skins were collected on North Keeling itself.

Adults.

Coll. No.	Date	Sex	Total Length	Tail	Wing Flat	Tarsus	Bill to Gape	Exposed Culmen
F18.*	30: 1:41	♂	878	405	565	25	119	102
F23.*	30: 1:41	♂	859	401	540	26	118	96
F24.*	30: 1:41	♂	799	314	570	27	117	98
F29.*	17: 2:41	♂	847	371	580	25	119	97
F17.	30: 1:41	♂	894	383	599	26	122	104
F47.*	4: 7:41	♂	914	402	612	28	127	106
F48.*	4: 7:41	♂	888	393	590	27	120	103
F49.*	4: 7:41	♂	948	428	590	28	126	108
F50.*	4: 7:41	♂	908	397	592	27	122.5	101
F51.*	4: 7:41	♂	903	383	578	27.5	125	104
F52.*	5: 7:41	♂	889	401	607	28	122	104
CM2.	5: 7:41	♂	916	409	557	27	120	102
F19.*	30: 1:41	♀	920	410	604	26	130	109
F20.*	30: 1:41	♀	908	401	584	27	125	105.5
F21.*	30: 1:41	♀	926	406	552	27.5	128	108
F22.*	30: 1:41	♀	914	396	581	27	131	113
F40.*	4: 7:41	♀	956	422	614	30	143	123
F41.*	4: 7:41	♀	982	439	637	28	137	118

Coll.
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Coll. No.	Date	Sex	Total Length	Tail	Wing Flat	Tarsus	Bill to Gape	Exposed Culmen
F42.*	4: 7:41	♀	941	399	618	29	138	116
F43.*	4: 7:41	♀	972	423	614	30	141	123
F44.*	4: 7:41	♀	1,001	444	638	28	144	122
F45.*	5: 7:41	♀	999	438	630	29	141	119
F46.	5: 7:41	♀	945	403	606	29	136	115
F53.*	5: 7:41	♀	913	392	596	29	135	114
CM1.	5: 7:41	♀	968	416	616	29.5	144	122
<i>Immature birds (Heads white or whitish).</i>								
F3.*	10: 1:41	♂	941	408	597	27	125	106
F13.	26: 1:41	♂	858	360	620	25	118	104
F25.	30: 1:41	♂	874	381	617	29	122	108
F26.	30: 1:41	♂	802	297	528	29	122	107
F12.*	22: 1:41	♀	972	398	639	31	140	122
F14.	30: 1:41	♀	914	359	596	30	142	122
F15.*	30: 1:41	♀	875	298	540	30	141	119
F16.	30: 1:41	♀	904	365	588	29	142	118
F28.*	10: 2:41	♀	967	413	648	29	144	123

Soft parts: the colouring of the soft parts differs with age and sex, except that the irides are always dark brown; adult *males* in full breeding plumage have the eyelids black, the bill black lined with light grey on the upper surface of the maxilla, the gular skin vermillion and the legs and feet black with the pads washed with orange; slightly younger or resting *males* (Nos. F.17, 18, 23, 24 and 29) have the bill mid or slate grey, the gular skin light vermillion and the feet very dark grey, with the pads and legs off-white; first juvenile plumage *males* have the eyelids very light blue, with the free border greyish or slightly mauve, the bill very light blue or a light purplish grey, almost white, the gular skin a very light blue or blue grey and the legs and feet off-white; adult *females* in full breeding plumage have the eyelids a full madder pink, the bill a light salmon pink, the gular skin the same colour, and the legs and feet a light, dull purplish pink; slightly younger or resting *females* (Nos. F.19-22) have the eyelids pink, the bill grey or slate-grey, often with the mandible washed with pink, gular skin smoky purple, legs and feet a watery pink or off-white; first juvenile plumage *females* have the eyelids white or very pale blue, the bill a very pale mauve grey, almost white, the gular skin very light grey and the legs and feet off-white.

The Lesser Frigate-bird breeds on North Keeling in company with the preceding species. It is slightly more plentiful, and in 1941 there was a total of 1,000-1,250 breeding pairs. The general habits, annual rhythm and months of laying (early May to the beginning of July) would seem to be the same in the two birds. Ten eggs measured on North Keeling, of which five were retained, ranged from 62-67 mm. in length and 40-47 mm. in breadth, average 64.2 × 44.1 mm.

Young birds seen at the beginning of July were similar to those recorded for *F. ariel* above, except that the early coverts on the head were almost white. Immature birds collected in January apparently show only one juvenile plumage. This is roughly the same as the plumage acquired by a nestling female taken back to Home Island in July 1941 and reared in captivity.

The head and neck are ivory white; in some examples a few pale sandy rufous feathers, with smoky centres, are mixed with the white ones. The remiges, rectrices and rump feathers are black. The long scapular feathers are the same colour, with the shorter scapulars and the feathers of the back dark brownish black, slightly paler towards their tips. The upper wing-coverts are also a dark brownish black, with a bar of feathers lightly tipped with very pale drab, dropping almost to ivory white at the edge, running diagonally from the elbow to the wrist. This bar is much less conspicuous here than in the young *ariel*. The underparts are roughly the same, with the under-wing-coverts and under tail-coverts black, the belly and lower flank white, and the breast dark brownish black with a median patch on the forebreast containing some ivory white or sandy rufous feathers. Forwards this patch merges into the ivory white of the throat, though in one case pale sandy feathers continue to the margin of the bare gular area. It should be noted that this plumage is very different from the first juvenile plumage recorded by the present writer for *F. m. minor* on Christmas Island (1947: 134-6), and largely from that recorded by van Bemmelen (van Bemmelen and Hoogerwerf, 1940: 427), for the birds collected on Gunong Api in the Banda Sea. The head is much whiter, but the wing bar much less conspicuous and the large median rusty red patch on the breast is very much reduced or absent. Neither is there any indication seen of the smoky coloured head with a white breast and rufous median patch which comprises an intermediate stage on that island. Individual variation is of course, fairly wide, but the above general observations apply to all the birds seen in addition to those now retained in the Raffles Museum collection.

The Lesser Frigate-bird occurs on a number of islands spread over the tropical portions of all three Oceans. The typical race *F. m. minor* (Gmel.) is known to breed on Christmas Island and Gunong Api in the Banda Sea. I examined a long series of these birds on Christmas Island in 1939-40, and there is no doubt in my mind that the North Keeling subspecies is clearly distinct from the typical one. No colonies are known from the north-western coast of Australia, but another race, *F. m. aldabrensis* Mathews, occurs in the western Indian Ocean, nesting on the Cosmoledo atoll and on islets in the lagoon of Aldabra (Betts, 1940: 500; Vesey-Fitzgerald, 1941: 530-1). Mathews (1914: 118-9) defines his race on the largest measurements of an adult female, giving exposed culmen 116 mm. and wing 621 mm. The North Keeling birds are apparently larger than this; the exposed culmen in the adult females in the present series ranges from 105.5-123 mm. and in the juvenile females

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NOTES ON THE BIRDS OF THE COCOS-KEELING ISLANDS

from 118-123 mm. The present series is also slightly larger than the examples of the typical race from Christmas Island recorded by Chasen and from Gunong Api by van Bemmell.

The figures for their two series are quoted below, for comparison with the North Keeling specimens.

Cat. No.	Sex	Total Length	Tail	Wing Flat	Tarsus	Bill to Gape	Exposed Culmen
<i>Christmas Island (Chasen, 1933: 72).</i>							
	♂	855	390	560	—	113	96
	♂	880	384	570	—	116	98
	♂	859	370	564	—	116	97
	♂	—	—	552	—	—	95
	♂	—	370	566	—	—	92
	♂	930	415	587	—	131	107
	♀	—	—	592	—	127	107
	♀	953	407	582	—	126	105
	♀	910	385	—	—	129	108

Gunong Api, Banda Sea (van Bemmell and Hoogerwerf, 1940: 426-7).

9093	♂	—	382	564	—	103	89
9094	♂	—	(370)	572	—	113	94
9095	♂	—	393	551	—	110	93
9096	♂	—	397	556	—	115	98.5
9090	♀	—	426	578	—	130	110
9091	♀	—	405	561	—	127	110
9092	♀	—	348	609	—	127	107

Immature birds

9085	♂	—	247	410	—	110	93
9087	♂	—	298	491	—	113	95
9086	♀	—	306	470	—	110	95
9088	♀	—	330	520	—	128	110
9089	♀	—	358	562	—	118	100

The exposed culmen in the four Christmas Island females recorded by Chasen ranges from 105-108 mm., and the wing pressed flat from 582-592 mm. in three examples; in nine immature females which I took on Christmas Island in September/October 1940 the ranges of the exposed culmen is 100.5-113, average 108 mm., and the range of the wing flat 527-613 mm., average 570.3 mm. Van Bemmell's three adult females range, culmen 107-110 mm. and wing flat 561-609 mm.

Phaethon rubricauda westralis Math. Redtailed Tropic-Bird.

Phaethon rubricauda westralis Mathews, Austr. Av. Rec. i, 1912, p. 88. West Australia.

Phaethon rubricauda, Wood-Jones, 1912, p. 344.

Local name, "*Burong Buntut Merah*". In conversation this bird and the next are often both referred to merely as "*Burong Buntut*".

The following two specimens were taken on Pulo Luar (Horsburgh Island) on 20 September, 1941.

Coll. No.	Date	Sex	Total Length	Tail	Wing Flat	Tarsus	Bill to Gape	Exposed Culmen
V10.	20: 9:41	♂	709	354	324	30	91	62
V11.	20: 9:41	♀	798	384	347	31	94	65

The Raffles Museum collection also contains the following two adult specimens collected by the author on Christmas Island.

Coll. No.	Date	Sex	Total Length	Tail	Wing Flat	Tarsus	Bill to Gape	Exposed Culmen
D40.	7:12:40	♂	712	334	349	32	92	63
D35.	7:12:40	♀	697	299	336	39	95	65

Soft parts: there is no apparent difference between the colouring of male and female birds; iris, very dark brown; eyelids, black; bill, bright vermillion red, slightly yellowish at the base of the mandible and with a black streak through the nostril; legs and the proximal portion of the feet, bluish grey; distal portion of the feet and the claws, black.

In 1941 this bird was seen over the main atoll only at wide intervals, and it was not observed on North Keeling during the two visits to the island. One pair was found breeding on Pulo Luar in the main atoll in June. The birds were nesting on the ground, under the shelter of a bush, among coconut palms about 50 yards from the sea. This is appreciably different from the site normally occupied by this species on Christmas Island, except for the use of a screen of vegetation, but apparently similar to that chosen most widely on the Pacific islands. The single egg lay in a slight depression in the sandy earth, devoid of lining. The shell is thick with a fine matt surface. It measures 63.5 × 44.5 mm. The colour is a very pale pinkish white thickly covered with dark purplish horn specks which in parts cover the ground-colour completely. No birds were seen in juvenile or immature plumages.

This is apparently the most westerly known breeding ground of the subspecies *westralis*. Eastwards it nests on Christmas Island, Houtman's Abrolhos off the west coast of Australia (Serventy & Whittell, 1948: 121) and Gunong Api in the Banda Sea (van Bemmelen and Hoogerwerf, 1940: 451-7). The typical race occurs in the western Indian Ocean, breeding on Round Island near Mauritius, Assumption, Aldabra and islands of the Cosmoledo atoll. The only significant difference between the two is in the length of the bill. Mathews (1912: 88) gives 76-80 mm. for the exposed culmen in typical *rubricauda* from Mauritius; 14 adults of *westralis* measured on Christmas Island varied from 58-65 mm. (1949: 100-4). The Cocos-Keeling birds are thus within the range of the Christmas Island specimens, which they resemble in every other respect. They are certainly of the same race, and may possibly be strays from that island. I am not fully satisfied that the Redtailed Tropicbird is consistently resident on the Cocos-Keeling Islands.

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Wood-Jones (1912: 344) records it as breeding on Pulo Atas (South Island) in small numbers during his stay on the atoll, but all other observers record only *lepturus*, which he missed, and not *rubricauda*. Bennett (1860: 89) describes an almost mature Whitetailed bird from Cocos-Keeling; Forbes (see Nicholson, 1882: 70) found only *P. lepturus* breeding there, present in small numbers, as it still is, on Pulo Panjang; and a photograph supplied to Chasen (1935: 68) by Charles Clunies-Ross, in an attempt to determine which is the tropic-bird of the islands, appeared to be of the same species. It may be that vagrants from the much larger colony on Christmas Island (400-600 breeding pairs in 1938-40), 530 miles further east, reach the Cocos-Keeling Islands at intervals and occasionally breed there, without establishing a permanent resident population. The accounts given by Alexander (1922: 476) and Serventy & Whittell (1948: 121) of the Houtman's Abrolhos colony suggest that it fluctuates in numbers from season to season, and that in some years no birds nest there. Whittell also reports an instance of what must be vagrant nesting, a bird which was found incubating under the shelter of a driftwood log on an open frequented beach near Busselton, southwestern Australia, in November, 1939. This, incidentally, is the only other recorded breeding site of *westralis* in Australian territory. Peters's "islands off the north-west coast of Australia" (Peters, 1931: 78) is too ambitious.

Phaethon lepturus lepturus Daud. Whitetailed Tropic-Bird.

Phaethon lepturus Daudin, Buffon's Hist. Nat. ed. Didot, Quadr. xiv, 1802, p. 319: Mauritius.

Phaethon candidus; Forbes, 1885, pp. 33 and 44.

Local name, "*Burong Buntut Panjang*".

The following eight specimens were retained and are now in Raffles Museum collection. Nos. 12, 17 and 18 were taken on Pulo Panjang, Nos. 13-15 and 19 on Pulo Luar and No. 16 on North Keeling.

Coll. No.	Date	Sex	Total Length	Tail	Wing Flat	Tarsus	Bill to Gape	Exposed Culmen
V12.	13: 3:41	♂	651	355	277	25	76	51
V13.	26: 2:41	♂	678	405	274	23	67	48
V15.	23: 2:41	♂	772	474	155+	23	72	49
V16.	30: 1:41	♂	707	416	279	23	72	50
V17.	2:10:41	♂	636	384	274	24	74	50
V18.	2:10:41	♂	640	356	281	24	73.5	50
V19.	17:10:41	♂	790	501	273	23	72	48
V14.	26: 2:41	♀	775	482	276	24	68	50

Soft parts: there is no apparent difference between the colouring of male and female birds; iris, dark brown; eyelids, black; bill, yellowish grey, almost grey at the base with a dark grey line through the nostril; legs and feet, jet black, except for the inner toe and a small patch in the inner web which are a very light blue-grey, almost white.

This would seem to be the true tropic-bird of the islands. It breeds in small numbers on North Keeling and Pulo Panjang (in the main atoll). Single eggs were found on the latter island in May and June. They were in sites similar to the nest of *rubricauda* described above, shallow depressions in the sandy ground partly sheltered from sun and wind by straggly bushes. The eggs were ovoid, with thick chalky shells and a fine matt surface. They measure 53×37 and 53×39 mm. The ground colour is a light terre verte, thickly, almost completely, covered with a fine, dark umber-purple blotching, the markings being slightly paler and thinner round the middle and at the pointed end. No chicks or immature birds were seen. The local Malays say that they have only found eggs on the ground. According to Vesey-Fitzgerald (1941: 530) this bird is a much more versatile nester in the Seychelles group, breeding in hollow trees high up in the mountain forests on the larger islands, and in holes in the ground or under overhanging rocks on the smaller ones. Stanley Gardiner (1903 (1): 369) also records it nesting in trees in the Maldive Archipelago.

Lepturus was not plentiful on the Cocos-Keeling Islands in 1941, and it is doubtful if there were more than 10-15 pairs in the group. Its relative scarcity may possibly be associated with its ground-nesting habits. It is significant that though only 4 of the 11 sea birds breeding on North Keeling lay in bushes or trees they represent between them over 80% of the total population. Land crabs, particularly *Cenobita rugosus* M.-Edw. and *C. perlatus* M.-Edw., are abundant on North Keeling, while, as we have seen, the local inhabitants have virtually driven all sea birds from the main atoll.

These islands are the most easterly known breeding ground of the typical race of *P. lepturus*. It also occurs as a nesting bird in the Mascarene Islands (Baker, 1929: 293), the Seychelles (Betts, 1940: 503-4; Vesey-Fitzgerald, 1941: 530) and the Maldives (Gardiner, *loc. cit.*). The species is represented on Christmas Island by a race peculiar to the island, *P. lepturus fulvus* Brandt, which differs from all other tropic-birds in having the general colouring a rich golden apricot instead of a satiny white. This latter bird apparently nests only in small cavities in the trunks of dead or dying trees at a height of 25-50 feet from the ground; a favourite site is a hollow that has rotted inwards where a main branch has fallen away. The limited observations that were possible suggest that there the majority of the eggs are laid between June and October (Gibson-Hill, 1947: 143-6). *Fulvus* wanders some distance from Christmas Island and has been recorded several times in the region of Java Head. I myself have seen it midway between Christmas and the Cocos-Keeling Islands, sporting at some

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NOTES ON THE BIRDS OF THE COCOS-KEELING ISLANDS

height above the water with two adults of the typical *lepturus*. It is said that is occasionally reaches the Cocos-Keeling Islands, and Chasen (1935: 68) includes them in its range; but none was seen during my stay there and I know of no examples from this locality. No V 19 in the present collection, when first taken, had a fine light apricot-yellow blush on the feathers of the neck, breast and belly, like the roseate bloom encountered on a breeding *rubricauda*. It was most marked, but very far removed from the full golden apricot of *fulvus*.

* *Turdus javanicus erythropleurus* Sharpe. Horsfield's Thrush.

Turdus erythropleurus Sharpe, Proc. Zool. Soc. 1887, p. 515: Christmas Island.

Merula erythropleura, Wood-Jones, 1912, p. 345.

Local name, "*Burong Gantas*"; the origin of the name is obscure. On Christmas Island this bird is called "*Mërbah*", which is used widely for thrush-like birds.

The following twenty skins were retained and are now in the Raffles Museum collection. Nos. 7 to 9 inclusive were taken at the south end of Pulo Panjang, the remainder on Pulo Luar (Horsburgh).

Coll. No.	Date	Sex	Total Length	Tail	Wing Flat	Tarsus	Bill to Gape	Exposed Culmen
MC4.	21:12:40	♂	221	84	110	32	30	22
MC6.	21:12:40	♂	216	87	116	33	29	22
MC7.	12: 1:41	♂	227	89	112	34	30	22.5
MC10.	11: 2:41	♂	225	87	108	34	29	21
MC12.	11: 2:41	♂	234	90	119	34	30	22
MC13.	11: 2:41	♂	229	87	112	34	29	22
MC15.	17: 2:41	♂	233	87.5	117	33	29	22
MC16.	17: 2:41	♂	225	85	109	33.5	28	21
MC19.	26: 2:41	♂	216	79	105	31	28	21
MC3.	21:12:40	♀	222	86	110	32.5	30	22
MC5.	21:12:40	♀	219	85	112	33	31.5	22
MC8.	12: 1:41	♀	224	80	109	34	29.5	23
MC11.	11: 2:41	♀	219	80	110	33.5	30	23
MC14.	17: 2:41	♀	219	81	110	33	29	21.5
MC17.	26: 2:41	♀	217	84	101.5	33	28	22
MC18.	26: 2:41	♀	220	81	102	32	29	22
<i>Immature birds</i>								
MC1.	21:12:40	♂	220	83	105	31	29	22
MC9.	12: 1:41	♂	152	28	79	34	26	18
MC20.	26: 2:41	♂	221	84	110	33	28	21
MC2.	21:12:40	♀	214	78	106	32	29	21

NOTES ON THE BIRDS OF THE COCOS-KEELING ISLANDS

The specimens collected show no points of difference from the birds taken on Christmas Island, the taxonomics of which are discussed by Chasen (1933: 83-4). Eggs and young were found on the Cocos-Keeling Islands between December and May, and it seems probable that this period corresponds roughly to the breeding season there. Immature birds with speckled breasts were particularly plentiful from January to June. On Christmas Island the breeding season runs from early October to the Middle of March. On the 1941 data, therefore, this bird seems to be breeding rather later in its new home than it does in its old one.

There is also, apparently, an interesting change in its diet. On Christmas Island *Turdus* feeds largely on insects, of which there is a very plentiful supply. Free surface water is also available to it throughout the year in at least parts of the island. In addition, in the wetter months and for some time afterwards the pock-marks in the limestone, which abound everywhere, always retain a few ounces or more of rain. A party of six of us lived in the jungle for two days shortly after the beginning of the dry season with this as our sole source of water. On the Cocos-Keeling Islands, on the other hand, there is no fresh surface water, other than such as may be put down near the settlements for domestic birds. Here the thrush is very partial to the succulent fruit of the Tropical Cherry, *Muntingia calabura* Linn. About half the stomachs examined contained no other food remains. The Cherry is an introduced tree, with a limited distribution on the atoll, and it seems probable that this is an important factor in limiting the spread of the thrush. The need for water or juicy fruits would also account for the bird's disappearance from the island of North Keeling. In the days when parties were staying on the island for a few months each year, in order to gather coconuts and fell timber, vegetable gardens of a kind were maintained there. These, and the water put down for the domestic birds, may have enabled the thrushes to tide over the dry months. The settlement was usually occupied from late October to January, and the rain falls mostly in the period from December or January to July or August.

* *Zosterops natalis* Lister.

Christmas Island White-eye.

Zosterops natalis Lister, Proc. Zool. Soc. 1888, p. 518, pl. 27: Christmas Island.

Zosterops natalis, Wood-Jones, 1912, p. 345.

Local name, "*Burong Ringin*", probably from the old Christmas Island name "*Burong Waringin*". *Waringin* (= Malay *beringin*) is the tree *Ficus benjamina* Linn.

Mus. 22, 1950.

[255]

The following sixteen specimens, collected on Pulo Luar, were retained and are now in the Raffles Museum collection.

Coll. No.	Date	Sex	Total Length	Tail	Wing Flat	Tarsus	Bill to Gape	Exposed Culmen
K1.	3: 1:41	♂	127	48.5	60	23.5	17.5	13
K2.	14: 1:41	♂	132	49	61	23.5	16.5	12.5
K3.	3: 1:41	♂	129	47	59	22.5	16	12.5
K6.	14: 1:41	♂	134	49	61	22	16.5	13
K10.	11: 2:41	♂	131	48	60	23	15.5	12
K12.	11: 2:41	♂	132	49	62	22	16	12
K14.	11: 2:41	♂	134	50	61	22.5	16	13
K15.	11: 2:41	♂	133	48	59	23	17	12.5
K16.	11: 2:41	♂	128	46	58	22	16	12
K4.	3: 1:41	♀	131	46	60	22	16.5	13
K5.	3: 1:41	♀	132	47	58	23	17	12.5
K7.	14: 1:41	♀	132	48	62	22	16	13
K8.	14: 1:41	♀	131	50	62	23	16	13
K9.	11: 2:41	♀	135	50	60	22	16	12
K11.	11: 2:41	♀	132	49	61	23	16	11.5
K13.	11: 2:41	♀	135	49	62	22	17	13

The Raffles Museum collection also contains the following specimens taken by the present writer on Christmas Island in November and December 1940.

Coll. No.	Date	Sex	Total Length	Tail	Wing Flat	Tarsus	Bill to Gape	Exposed Culmen
C1.	8:11:40	♂	128	51.5	60	21.5	16.5	12
C6.	23:11:40	♂	126	52	63	21	17	13
C7.	23:11:40	♂	123	50	64	21	17	12
C9.	23:11:40	♂	125	49	62	22	17	13
C11.	23:11:40	♂	125	49	61	21	17	12
C13.	23:11:40	♂	122	50	61	21	17	13
C14.	23:11:40	♂	121	46	61	20.5	16	12
C15.	4:12:40	♂	130	51	60	21	16	12
C2.	8:11:40	♀	129	49	59	20	16	12
C3.	8:11:40	♀	129	50	61	20.5	15.5	11
C4.	22:11:40	♀	120	49	62	21	17	12.5
C5.	22:11:40	♀	131	52	63	22	16	12
C8.	23:11:40	♀	125	48	60	22	17	12
C10.	23:11:40	♀	128	51	61	22	17.5	13
C12.	23:11:40	♀	125	49	62	22	16.5	13
C16.	4:12:40	♀	126	45	58	22	17	13

Soft parts: there is no apparent difference between the colouring of the male and female birds; iris, rich chestnut; bill, black with the base of the mandible grey; legs and feet, greenish grey.

This bird again was introduced from Christmas Island by George Clunies-Ross. It occurs only on Pulo Luar, and it is probable that that is the only island on which an attempt was made to establish it. George Clunies-Ross kept the island as a private park, and in addition to the surviving birds also liberated the Christmas Island Imperial Pigeon, *Ducula rosacea whartoni* (Sharpe), which has failed to maintain itself and a mixed herd of feral Javanese deer, *Cervus unicolor russa* Müll. and Schleg. and *Muntiacus m. muntjak* (Zimm.), which have likewise disappeared. Wood-Jones (1912: 345) says that in 1905 it existed on Pulo Luar in some numbers, and Robinson

NOTES ON THE BIRDS OF THE COCOS-KEELING ISLANDS

(1912: 2) says that it was plentiful there at the time of his visit in 1912. It is still very common on the island and there were about 400 birds present in 1941, but it has never spread to any of the other islands.

The specimens collected show no significant difference from the birds on Christmas Island, the taxonomics of which are discussed by Chasen (1933: 84-5) and field notes given by the present writer (1947: 155-7). Only one nest was found, containing a single egg, in March. Undoubtedly more data are required before one can estimate the month during which laying normally occurs. On Christmas Island occasional individuals may be found nesting at any time, but the majority start between the beginning of September and the end of January. The nests are usually built in the fork of a very thin branch, 5-15 feet from the ground, in a medium sized bush. Occasionally they may be appreciably higher in a tree. The nest is firmly attached to the arms of the fork from which it is suspended, and they may even be built into the rim. The nest is fairly neat and compact, with the cup about 55 mm. in diameter and 20-25 mm. deep, and carefully lined with fine fibres. It is very similar to nests of *Z. palpebrosa williamsoni* Rob. and Kloss found on Singapore Island. The egg of *natalis* found on Pulo Luar was a uniform light, watery blue and measured 17×12.5 mm. Ten eggs measured on Christmas Island were 16.5-18.5 mm. in length and 12-13 mm. in breadth, average 17.8×12.4 mm. A complete clutch there was found to contain 2 eggs, or occasionally 3.

* *Padda oryzivora oryzivora* (Linn.). Java Sparrow.

Loxia oryzivora Linn., Syst. Nat. 10th. ed. 1758, p. 173: "Asia" = Java.

Padda oryzivora, Forbes, 1885, p. 44.

Java Sparrow, Wood-Jones, 1912, pp. 299-300.

Local name, "*Burong Gēlatek*". The name has been introduced with the bird from Java.

The following fourteen skins taken on Pulo Tikus have been retained and are now in the Raffles Museum collection.

Coll. No.	Date	Sex	Total Length	Tail	Wing Flat	Tarsus	Bill to Gape	Exposed Culmen
K17.	13: 1:41	♂	151	48	74	19	14	15
K18.	13: 1:41	♂	156	49	75	20	14.5	16
K20.	13: 1:41	♂	151	48	73	20.5	15	16.5
K21.	13: 1:41	♂	152	49	72	20	14	16
K22.	13: 1:41	♂	149	51	76	20.5	14	16
K25.	13: 1:41	♂	148	47	71	20.5	13.5	15
K26.	10: 2:41	♂	145	45	70	20	14.5	16
K29.	3: 3:41	♂	146	47	72	20	14	16
K19.	13: 1:41	♀	150	44	70	19.5	14	15.5
K23.	13: 1:41	♀	146	47	69	20.5	13.5	15
K24.	13: 1:41	♀	144	42	68	19	13	15
K27.	10: 2:41	♀	144	46	71	19.5	14.5	16
K28.	3: 3:41	♀	147	50	68	19	14.5	15
K30.	3: 3:41	♀	151	48.5	71	19.5	14.5	15.5

Mus. 22, 1950.

[257]

The following twelve skins were taken on the north coast of Christmas Island, in the neighbourhood of the settlement at Flying Fish Cove, in November and December 1940. They also are now in the Raffles Museum collection.

Coll. No.	Date	Sex	Total Length	Tail	Wing Flat	Tarsus	Bill to Gape	Exposed Culmen
D42.	22:11:40	♂	142	46	72	20	15.5	16.5
D44.	22:11:40	♂	146	44	70	19	15	16
D45.	22:11:40	♂	146	45	73	20	14.5	16
D46.	23:11:40	♂	147	44	70	20	15.5	16.5
D47.	23:11:40	♂	148	47	73	20.5	16	17
D41.	22:11:40	♀	141	44	74	19.5	16	15
D43.	22:11:40	♀	142	45	71	20	14.75	15
D48.	23:11:40	♀	146	46.5	72.5	20	16	17
D49.	23:11:40	♀	145	43	70	20	15	16.5
D50.	23:11:40	♀	142	40	70	19	15	16
D51.	2:12:40	♀	151	47	72	20	15	16.5
D52.	3:12:40	♀	145	48	74	21	14.5	15.5

Soft parts: there is no apparent difference between the colouring of male and female birds, but juveniles have the colours paler and with less body to them; iris, red-brown; eyelids, blue-grey with the free border a full purple-pink; bill, a strong mauve pink, white along the gape and at the tip; legs and feet, a pale pinkish mauve.

It would appear from the comments of Keating (in Holman, 1846: 382) that this bird had been liberated on the main atoll before 1828, though Darwin makes no reference to it. Forbes (1885: 44) does not mention it in his description of the island but gives it in the list of birds at the end of the chapter, "in captivity". Wood-Jones (1912: 299-300) in his account of the introduced elements in the Fauna says that in his day it was the most numerous bird on the southern islands, but he omits it from the formal list given at the end of his book; it does not, therefore, occur in the paper which he wrote for the Proc. Zool. Soc. Lond. (1909: 137-42). In 1941 it was very plentiful on Pulo Tikus, and occurred in small numbers on Pulo Luar and Pulo Selma. I did not find it on any of the other islands, but its conspicuousness on these three may well have led Wood-Jones to make his general statement. There were about 200 birds on Pulo Luar, about 250 on Pulo Tikus and roughly 200 on Pulo Selma, making a total for the group as a whole of about 650. This does not seem to be a very enterprising species, though it may easily become dominant in a small area. It was liberated in the region of Flying Fish Cove on Christmas Island between 1904 and 1923, but by 1940 it had extended its range no further than the whole length of the north coast road, a distance of about 6 miles, and 2 miles along the railway line towards the south end of the island. Similarly it has been liberated in the neighbourhood of several towns in Malaya, but except in the case of Alor Star, where it has established itself in the mangrove zone on the coast 8 miles away, it has not spread far from human habitation. It seems probable that away from

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the countries of its natural distribution it is usually to some extent dependent on grain or rice derived from the untidy habits of men. It is significant that the three islands on which it occurs in the Cocos-Keeling group are the three permanently inhabited, and most birds there, as we have seen, thrive best away from man.

The specimens collected show no points of difference from the birds on Christmas Island, or from specimens from Java in the Raffles Museum collection. Eggs and very young birds were found on the Cocos-Keeling Islands in the months from May to August. On Christmas Island I found only 6 nests, 4 between May and July and 2 in August. The data are scant, but such as they are they show it breeding on the Cocos-Keelings over the same period as on Christmas Island.

Part 2

Checklist of the Birds of the Cocos-Keeling Islands

The list is based primarily on the specimens and field-notes collected during my stay on the islands. In the case of the vagrants and visitors the data has been considered in the light of the records published by earlier observers, and of information obtained from some of the local Malays. The authors whose accounts have been used are listed at the end of this section, together with a brief statement of the periods during which they were on the Cocos-Keeling Islands. In addition four other naturalists are known to have visited the main atoll, the Rev. E. C. Spicer (20-28 August 1885), Dr. H. B. Guppy (August-October 1888), H. C. Robinson (4-8 October 1912) and Richard Archbold (approximately a week about July/August 1939). Only two of these, Guppy (1889) and Robinson (1912), appear to have published papers or reports, and neither makes any significant contribution to our knowledge of the avifauna.

The 1941 collections yielded examples of 17 species nesting on the islands, of which 4 are known to have been introduced, and a further 17 strays or non-breeding visitors. To these must be added 1 vagrant taken by Forbes, but not found again in 1941 (*Herodias nigripes* (Temm.), identified by Nicholson, 1882: 70). I have also admitted the Pintail Snipe, *Capella stenura* (Bp.), on the evidence quoted below, though the diagnosis still awaits confirmation, and 2 artificially induced residents which had disappeared long before my visit to the atoll. This gives a total of 32 birds (30 of which were confirmed in 1941) which can be said to occur or have occurred naturally, and 6 (4 present in 1941) which have been introduced and maintained

themselves for at least a short time. In addition there are a few feral domestic fowl on North Keeling, descended from stock taken over when the island was being visited regularly.

The birds appearing on this list can be divided into three groups. The first, marked by a double asterisk, comprises those which were breeding somewhere on the islands in 1941. These consist of 5 land birds (4 of which had been introduced) and 12 sea or coastal birds. The second group, described as visitors, consists of those species which would seem to arrive regularly, though in small numbers. In all cases they occur during the whole or part of the northern winter season. The last group, described as vagrants, comprises those species which would appear to occur irregularly at very wide intervals. Birds in the last two groups which I collected myself are marked with a single asterisk.

Obviously, in most cases, the direct evidence obtained from a stay as short as a year or less is not sufficient for one to decide with certainty whether a bird seen in very small numbers is a stray or a scarce but regular visitor. Earlier records can sometimes be of assistance, but in this case they do not yield very much of value. The only bird which had been noted by more than one of my predecessors is a snipe; and none were reported in 1941. I have therefore depended to some extent on information obtained from the more observant among the local Malays. In this I was helped considerably by the personal knowledge, and enthusiastic co-operation, of Sakmat a Cocos-Keeling Islander who worked for me as boatman. There are obvious pitfalls in this approach to the subject, but an attempt was made to obviate them as far as possible. To this end, following talks with Sakmat and a selection of his friends, I compiled a list, with descriptions, habitats and using their names, of the birds which they considered arrived in small numbers regularly, and those few which they thought came occasionally, at wide intervals. During the course of my stay we collected all the regular visitors which they had promised me except for one, which is almost certainly the snipe. We took several of the occasional visitors, but not a duck, which they say arrives in small numbers at very wide intervals; and which has been recorded, without specific data, by Forbes (1885: 44) and Wood-Jones (1909: 142). They also described a bird which I think must be a godwit ("like the Whimbrel but much paler and with a straight bill") and a large, brown or purplish brown heron, neither of which appeared in 1941.

Whenever a non-resident bird was taken several of the men were asked independently for its status and the name that they would give to it. This, together with the habitat in which it was found, was then checked against the advance information

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that I had collected earlier. In all cases the birds which they claimed as regular visitors were seen in small numbers, not as single records, and were species which might reasonably be expected to be reaching the atoll annually. The one point where we differed markedly in our views was in the case of the Bridled Tern, *Sterna anæthetus antarctica* Less. They regarded this bird as a breeding visitor, in small numbers, to North Keeling, but only one example was taken, or seen by me, during the whole period that I was there. It had not been reported by any previous visitor, though Chasen (1935: 47) includes these islands in its range. Finally they were using the same local name (*Burong Dali*) for both species, with a size epithet for distinction.

The inability of one's informants to differentiate between two particular species is one of the deficiencies of data obtained in this manner. It was obviously not possible to find out if Forbes's *Egretta garzetta* was occurring occasionally on the atoll, or had bred there within living memory, since to the Malays all white egrets are the white phase of *Demigretta sacra*. In addition some small birds, both Charadriiformes and Passeriformes, may well occur at intervals singly, or in twos or threes, and escape notice. Wagtails may be arriving occasionally, and it is probable that one or two of the waders which I have marked as vagrants are really regular visitors in very small numbers. Over 20 per cent of the Islands' list as it stands is made up of "vagrants" taken in a single year. Such a figure is obviously too high for so short a collecting period. On the other hand I think that the birds listed as regular visitors are almost certainly correctly classified.

The nomenclature and order of this list follows Chasen's *Handlist of Malaysian Birds* (Bull. Raff. Mus. 11, 1935) so far as it is applicable. Two of the species given here, *Diomedea chlororhynchos* Gmel. and *Puffinus pacificus* (Gmelin), had not previously been recorded from the area covered by his list. The two frigate-birds may also be sub-species new to it. A more detailed account of the visitors and vagrants of which examples were taken in 1941 occurs in an earlier paper by the present writer (Ibis 91, April 1949: 221-243), and a checklist of the birds of Christmas Island, similar in form to this one, in *Notes on the Birds of Christmas Island* (Bull. Raff. Mus., 18, 1947: 87-165).

Several additional birds have also been recorded from the Cocos-Keeling Islands in previous accounts, but it would seem that no examples have been taken. In some cases the identifications given are too vague for their inclusion in the following list. As noted above, both Forbes (1885: 44) and Wood-Jones (1909: 142) report the presence of duck on Pulo Panjang, the former

saying that he had been told that migrants arrived, and the latter that they were resident there. Chasen (1935: 63) suggests that the birds might be the Wood-Teal, *Anas g. gibberifrons* (S. Müll.), of which a single stray was taken on Christmas Island by Dr. Hanitsch in 1904. None were seen or reported in 1941. Wood-Jones (1912: 345) also reports a wagtail arriving on Pulo Tikus, but again no specific identification is given. Two species occur on the Christmas Island list as vagrants, the Grey Wagtail, *Motacilla cinerea melanocephala* Pall., and the Blue-headed Wagtail, *M. flava similima* Hart. Finally Wood-Jones (1909: 142) says that "Curlew are said to breed on some of the islands, but I never found the eggs, nor did I ever obtain a bird for identification". Such birds are certainly not nesting on the atoll, nor were any Curlew seen in 1941. It is quite probable that Wood-Jones's "curlew" was actually the Eastern Whimbrel, *Numenius phaeopus variegatus* (Scop.), which occurs regularly as a visitor in small numbers from September to May, as it does on Christmas Island.

There are also three identifications which are regarded by the present writer as erroneous, and accordingly not accepted here. Forbes (1885: 44) lists the Woodcock, *Scolopax rusticola* Linn., as a migrant, without further comment. Earlier (*tom. cit.*: 34) he says that "a species of Snipe and a Teal visit the islands every February and March in large numbers...", but in this passage makes no mention of the Woodcock. On the other hand the Snipe is the only bird given in the earlier paragraphs which is not included in the list on p. 44. No further evidence has come to light of the presence of Woodcock on the islands, and it seems probable that his listing of it was in error for the Snipe. Wood-Jones (1909: 140) describes Abbott's Booby, *Sula abbotti* Ridgw., breeding on bare ground on North Keeling. No other observer has noted this remarkable phenomenon, but there was no doubt that in 1941 the Masked Booby, *Sula dactylatra bedouti* Math., was breeding in small numbers in this situation. Since this bird is noted from the Cocos-Keeling Islands as far back as Hume (*Stray Feathers*, 5, 1877: 310) and not recorded by Wood-Jones it would seem certain that he has erroneously recorded *S. dactylatra* as *S. abbotti*. Finally Wood-Jones (1909: 140) gives *Fregata aquila* Linn. as one of the two frigate-birds nesting on North Keeling. This was a correct diagnosis for the period at which he was writing. Subsequently Mathews (*Austral Av. Rec.*, 1914: 117) showed that *F. aquila* is confined to Ascension Island, in the Atlantic Ocean, and placed the remaining birds previously ascribed to it in two further species, *F. minor* and *F. andrewsi*. The former is widely spread, and is the bird which Wood-Jones saw; the latter breeds only on Christmas Island and possibly the Anamba Islands, in

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NOTES ON THE BIRDS OF THE COCOS-KEELING ISLANDS

the South China Sea. Unfortunately Peters (Checklist of the Birds of the World, 1, 1931: 95) and Chasen (1935: 66) have assumed that the *F. aquila* of Wood-Jones must be *F. andrewsi*, presumably on the grounds of proximity. Actually *andrewsi*, with which I became well acquainted during my stay on Christmas Island, was certainly not nesting on the Cocos-Keeling Islands in 1941, nor was it even present as a non-breeding visitor.

The following are the birds found on the Cocos-Keeling Islands in 1941, together with the earlier records, outlined above, which are accepted here.

Species.

Status.

PHASIANIDAE.

- ** *Gallus varius* (Shaw & Nodd.). Introduced on Pulo Pan-
Green Jungle-Fowl. jang, in the main atoll,
before 1880 (see Forbes,
1885: 44); still present
in small numbers.

COLUMBIDAE.

- Ducula rosacea whartoni* Introduced on main atoll
(Sharpe). about 1890-95; practi-
Christmas Island Imperial cally extinct by 1906
Pigeon. (Wood-Jones, 1909:
137); not present in
1941.

RALLIDAE.

- ** *Rallus philippensis andrewsi* Resident. Plentiful on
(Math.). North Keeling and Pulo
Philippine Rail. Luar; also present in
smaller numbers on Pulo
Selma and Pulo Panjang.

CHARADRIIDAE.

- * *Charadrius apricarius fulvus* Regular visitor, small
Gmel. numbers, October-April;
Eastern Golden Plover. main atoll.
* *Charadrius l. leschenaultii* Less. Regular visitor, small
Large Sand-Plover. numbers, October-April;
main atoll.
* *Charadrius asiaticus veredus* Vagrant (Gibson-Hill, 1
Gould. imm., 17 October 1941).
Caspian Plover.

Species.

- * *Numenius phaeopus variegatus*
(Scop).
Eastern Whimbrel.

- Capella stenura* (Bp.)⁷
Pintail Snipe.

- * *Arenaria i. interpres* (Linn.).
Turnstone.

- * *Tringa totanus eurhinus*
(Oberh).
Eastern Redshank.

- * *Tringa nebularia* (Gunn.).
Greenshank.

- * *Actitis hypoleucos* (Linn.).
Common Sandpiper.

Status.

Regular visitor, small numbers, September-May; main atoll, seen mostly on east side of Pulo Panjang.

Occasional visitor. Keating (in Holman, 1848: 382), Darwin (1845: 545), Forbes (1885: 34), and Wood-Jones (1909: 142) refer to single or visiting snipe; none seen 1941.

Regular visitor, small numbers, winter months; most numerous January and February; main atoll and North Keeling.

Regular visitor, small numbers, winter months; main atoll, seen mostly on flats at south end of lagoon.

Regular visitor, small numbers, winter months; main atoll, seen mostly on lagoon shore of Pulo Atas.

Regular visitor, small numbers, winter months; main atoll, seen mostly on more sheltered outer shores.

GLAREOLIDAE.

- * *Glareola pratincola maldivarum*
Forst.
Collared Pratincole.

Vagrant (Gibson-Hill, 2 ♀♀, 11 March 1941, Pulo Luar).

⁷ As shown above, Keating, Darwin, Forbes and Wood-Jones all claim to have seen or been told of snipe on the main atoll, apparently as visitors or vagrants; none were detected in 1941. Only one of these authors, Wood-Jones, seems to have taken a specimen, and this, a single stray from a small flock on Pulo Tikus, he identifies as the Common Snipe, *Capella g. gallinago* (Linn.). Undoubtedly snipe occasionally reach the main atoll, but identification was not one of Wood-Jones's strong points. From what we know of the range and relative numbers of the three species of *Capella* wintering in the Malaysian sub-region (see Gibson-Hill, this Journal, 1948: 105-119), it seems most likely that the bird straying to the Cocos-Keeling Islands is really the Pintail, *C. stenura*, as given here.

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NOTES ON THE BIRDS OF THE COCOS-KEELING ISLANDS

Species.

Status.

LARIDAE.

- * *Sterna hirundo longipennis*
Nordm.
Nordmann's Tern.
* *Sterna anaethetus antarctica*
Less.
Bridled Tern.
** *Sterna fuscata nubilosa*
Sparrm.
Sooty Tern.

Vagrant (Gibson-Hill, 1 ♀,
11 February 1941, two
seen, lagoon main atoll).
Vagrant (Gibson-Hill, 1 ♂,
5 July 1941, North Keel-
ing).

Mostly a breeding visitor,
North Keeling, Sept.-
Feb.; some birds present
throughout the year.

- ** *Anous stolidus pileatus* (Scop).
Common Noddy.

Mostly a breeding visitor,
500-750 pairs North
Keeling and about 20
pairs south end Pulo
Panjang, Dec.-June;
some birds present
throughout the year.

- ** *Gygis alba monte* Math.
White Tern.

Resident, main atoll and
North Keeling; breeds
North Keeling, Pulo Luar
and a few pairs Pulo
Tikus.

PROCELLARIIDAE.

- * *Diomedea chlororhynchus* Gmel.
Yellownosed Albatross.
** *Puffinus pacificus chlororhynchus*
Less.
Wedgetailed Shearwater.

Vagrant (Gibson-Hill, 1 ♂,
2 July 1941, north shore
Pulo Tikus).

Breeding visitor, North
Keeling, late August to
end February.

ARDEIDAE.

- Egretta garzetta nigripes*
(Temm).
Little Egret.

Vagrant (Forbes, 1 ♀, 6
February 1879, Pulo Pan-
jang).^s

^s Forbes (1885: 33) says that this bird, which he gives as *Herodias nigripes*, was nesting on the high *Pisonia* trees on Pulo Panjang, West Island, in company with the Reef Heron, *Demigretta sacra*. He only procured the one specimen which Nicholson (1882: 70) cites as above. This bird has not been recorded by any other visitors to the islands, and it seems probable that in claiming residence for it he was confusing it with the white phase of *Demigretta sacra* which certainly does nest on parts of the main atoll. It is unlikely that the felling of much of the *Pisonia* on Pulo Panjang between 1920 and 1922, when the kampong on Pulo Selma was being rebuilt, would have been sufficient to drive it away from the islands. The Reef Heron finds the crowns of the coconut palms an adequate substitute. In addition, the timber had not been taken from Pulo Panjang in 1905-6 and 1907, when Wood-Jones was on Cocos, and he does not include *nigripes* on his list.

Species.

- ** *Demigretta s. sacra* (Gmel.).
Reef Heron.

- * *Nycticorax n. nycticorax*
(Linn.).
Night Heron.

- * *Nycticorax caledonicus hilli*
Math.
Nankeen Night Heron.

Status.

Resident, main atoll and
North Keeling; breeds
North Keeling, Pulo Ti-
kus and Pulo Belanchi.

Vagrant (Gibson-Hill, 1 ♀,
13 October 1941, Pulo
Panjang).

Occasional visitor.

SULIDAE.

- ** *Sula dactylatra bedouti* Math.
Masked Booby.

- ** *Sula leucogaster plotus*
(Forst.).
Brown Booby.

- ** *Sula sula rubripes* Gould.
Redfooted Booby.

Resident, about 40-50 pairs,
North Keeling.

Resident, about 75-100
pairs, North Keeling.

Resident, about 3,500-4,000
pairs, North Keeling.

FREGATIDAE.

- ** *Fregata ariel* subsp.
Least Frigate-bird.

- ** *Fregata minor* subsp.
Lesser Frigate-bird.

Resident, about 750-1,000
pairs, North Keeling.

Resident, about 1,000-1,250
pairs, North Keeling.

PHAETHONTIDAE.

- ** *Phaethon rubricauda westralis*
Math.
Redtailed Tropic-bird.

- ** *Phaethon l. lepturus*
Lacép. & Daub.
Whitetailed Tropic-bird.

Resident, less than 5 pairs
main atoll; 1 nest found,
Pulo Luar.

Resident, about 10-15 pairs,
main atoll and North
Keeling; nests found on
Pulo Panjang.

FALCONIDAE.

- * *Circus ae. xuginosus*
(Linn.).
Marsh Harrier.

Vagrant (Gibson-Hill, 1
imm. ♂, 6 July 1941,
Pulo Selma).

STRIGIDAE.

- * *Bubo k. ketupu* (Horsf.).
Fish Owl.

Vagrant (Gibson-Hill, 1 ♂,
23 October 1941, Pulo
Selma).

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NOTES ON THE BIRDS OF THE COCOS-KEELING ISLANDS

HIRUNDINIDAE.

- * *Hirundo rustica gutturalis* Scop. Regular visitor, small numbers, September and October.
Eastern Common Swallow.

TURDIDAE.

- ** *Turdus javanicus erythropleurus* Sharpe. Introduced between 1885 and 1900; now fairly plentiful on Pulo Luar, Pulo Atas and Pulo Panjang.
Christmas Island Thrush.

ZOSTEROPIDAE.

- ** *Zosterops natalis* Lister Introduced Pulo Luar between 1885 and 1900; now plentiful, but still confined to the one island.
Christmas Island White-eye.

PLOCEIDAE.

- ** *Padda o. oryzivora* (Linn.). Introduced, possibly before 1828 (Keating), though Darwin does not refer to it; now plentiful in Pulo Tikus and present in small numbers on Pulo Luar and Pulo Selma.
Java Sparrow.

- Ploceella h. hypozantha*
(Sparrm.).
Golden Weaver-Finch.

Introduced; Forbes (1885: 34) says that he saw nests on Pulo Panjang (West Island); no subsequent records.⁹

Birds have been reported or collected by the following visitors who are arranged in chronological order. The dates immediately after their names give the periods, so far as they are known, during which they were on the islands. The references in brackets are the first publication of their records.

KEATING, A. S. About 12 months 1828/9 (Holman, J., *A Journey Round the World*, 4, 1846: 374-388).

⁹ J. G. Clunies-Ross told Dr. Forbes that the birds flew across the sea, probably from Java, to reach the Cocos-Keeling Islands, and that after breeding both adults and young left the atoll. He also said that they reached North Keeling, which Forbes did not visit, more frequently than the main atoll. Forbes only saw the nests. It must, I think, be taken that they were built by an introduced stock which failed to maintain itself. Clunies-Ross was not a reliable field naturalist, and told his visitors several very peculiar stories at different times.

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10. Dr. F. Wood-Jones revisited the atoll for a few weeks in 1907. This may be the reason for the addition of the *Motacilla* sp. which appears in the 1912 reprint of his notes on the Cocos-Keeling birds (1912: 345), but not in the original version in the *Proc. Zool. Soc. Lond.* (1909). Otherwise the two accounts are similar. His second visit was connected with personal matters. I have never seen a copy of the first edition of *Coral & Atolls*, which was published in 1910.

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